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My Dear Ma

I will write you  
a few lines to let you know  
why I have not been up before now  
I have had so much practice  
until I could not get off  
Just as soon as I can possible  
get off I will come up. for  
I begin to want to see you all  
right bad. My family is  
all tolerable well at this  
time my health is good &  
I am doing well with my  
practice. I have been going  
day & night for some two  
months. I have had some very  
bad cases of Bilious fever  
Mr Bates family is all  
well but Mrs B & she  
has Rheumatism in the  
shoulder very bad

I am in hopes you are  
all well, Sam Thomas  
Came down last Friday  
& he said you are all  
well. Some has been at  
my house ever since he  
Came down. He comes tomorrow  
for Mr Hadleys. Some  
40 miles below me  
give my love to all the  
family. Hoping to be free  
soon. My family sends  
love to you all.

Your True Son  
D. L. C. M.



AN EPITOME  
*L R M*  
OF THE  
PHYSIOLOGY,  
GENERAL ANATOMY,  
AND  
PATHOLOGY,  
OF  
BICHAT.

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BY THOMAS HENDERSON, M. D.

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COLUMBIAN COLLEGE, WASHINGTON CITY.

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PHILADELPHIA:  
CAREY, LEA & CAREY—CHESNUT STREET.

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1829.

*Physiol*

**EASTERN DISTRICT OF PENNSYLVANIA, to wit:**

**BE IT REMEMBERED**, that on the fourteenth day of March, in the fifty-third year of the independence of the United States of America, A. D. 1829, Carey, Lea and Carey of the said district, have deposited in this office the title of a book, the right whereof they claim as Proprietors, in the words following, to wit:

“An Epitome of the Physiology, General Anatomy, and Pathology, of Bichat. By Thomas Henderson, M. D. Professor of the Theory and Practice of Medicine in the Columbian College, Washington City.”

In conformity to the act of the Congress of the United States, entitled, “An act for the encouragement of learning, by securing the copies of maps, charts, and books, to the authors and proprietors of such copies, during the times therein mentioned.” And also to the act, entitled, “An act supplementary to an act, entitled, ‘An act for the encouragement of learning, by securing the copies of maps, charts, and books, to the authors and proprietors of such copies during the times therein mentioned,’ and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints.”

**D. CALDWELL,**

Clerk of the Eastern District of Pennsylvania.



K-Q.M28

H49

Biology  
Library

TO

**JOHN D. GODMAN, M. D.**

LATE PROFESSOR OF ANATOMY IN RUTGERS MEDICAL  
COLLEGE, NEW YORK.

SIR,

I dedicate this little volume to you, as a testimony of my respect for you as a man of learning, and especially in acknowledgment of your distinguished character as a teacher of anatomy.

I regret that ill health has compelled you to retire from a sphere of duty, in which you were doing so much good, and acquiring so much fame.

I consider you a conspicuous instance of what genius, industry, and honourable ambition will accomplish; an example which the American medical student should ever be proud to follow.

Great interest is felt by the medical profession and others in the restoration of your health. I partake largely of that feeling; and though personally a stranger to you, I am happy and sincere in assuring you, of the great respect of

Sir, your obedient,

And very humble servant,

**THOMAS HENDERSON.**

*Washington, November, 1828.*

M348129





## PREFATORY REMARKS.



THE works legitimately ascribed to Bichat are voluminous and expensive. In the French there are about ten volumes, in the translations seven; and they are not always, perhaps not generally, all found in private libraries. These circumstances in part, induced me to attempt an epitome of the works of this great man. The decisive motive was the fact, that his works at large are, from various causes, too little read by students, before they commence their public studies, or before they graduate. I allude now to the great proportion of medical students in the interior of the country. It has been frequently said too, that the arguments in support of his principles, and the experiments illustrating their truth, are detailed by Bichat with unnecessary prolixity and minuteness.

If any causes tend to keep from the medical student a familiar acquaintance with the writings of Bichat, they should be removed; if any thing can be done to render them more accessible, it should be done. I have thought, and the plan has been approved by judicious friends, that such an attempt as this volume exhibits might have these effects; and it will be a great source of satisfaction to me, if it in any measure succeeds.

In all the sciences there is a disposition to familiarize students with the most important authors, by reducing their works to the compendious form of manuals. This is done usually, in the aphoristic, or in the interrogatory style. The last has been pronounced, if not the

least useful, the least dignified. I have, after much consideration, determined to adopt the form of question and answer. I found this very useful and agreeable to me when a student; my private pupils have been happily aided by it; it certainly greatly facilitates the private instruction of pupils. This last reason, of the truth of which there can be no doubt, would have been sufficient to decide me. It appears to me also, that in submitting the question and giving the answer, the mind undergoes a double operation, favourably concentrates the student's attention, and leads to a correct intellectual result. I therefore readily submit it to the student of this work to decide, after he has completed the perusal of it, whether or not I have erred in adopting the catechetical method. If this method be generally unsystematic, it is replied that I give the system of Bichat, and that is my object. If, as was suggested by a medical friend, in pursuing the course most useful to students I have sacrificed the dignity of authorship, the latter is most freely surrendered in order to ensure the former.

On another account it is thought this work may be well received. Modern publications are interposed between the medical student and Bichat; and on this ground, that they omit his errors, embrace his truths, and introduce subsequent improvements. There is some foundation for this; but as to the supposed erroneous views of Bichat, may not "the stone which the builders rejected" be yet found the sure one for the building? And those views which are esteemed improved ones, have many of them yet to bear the sternness of critical and experimental investigation. It is scarcely to be expected that a student will, after reading the summaries of Horner, and of Bayle and Hollard on general anatomy, patiently explore the



long and intricate paths opened in the elaborate volumes of Bichat. On the contrary, I fear these books may materially tend to exclude Bichat from private libraries. If a compendium of the works of the *Father* of general anatomy can be made to accompany the recent publications, I humbly think it will conduce to the student's progress.

I have read with unmingled pleasure the General and Special Anatomy of Horner; and have seen with pride how favourably it is noticed abroad, and I know how much good it is doing at home. The volume of Bayle and Hollard is an excellent work, and deserving repeated and attentive perusal. But these works, although founded on the system of Bichat, should never supersede his writings. There are in the latter so many new, curious and authenticated speculations and facts, not to be found in any preceding or subsequent work, that they remain unrivalled in value, immortalizing the author.

To be valuable, such a work as I have executed, should be well done. Neither time nor devotion to the object have been spared. It has been my endeavour to catch the spirit and the meaning of Bichat, and to express them perspicuously. I do not suppose the work is free from error, but it is hoped that these errors are neither numerous nor important. I have depended on the French editions for the correctness of the book, but have been much aided by the translations.

Now that the works of Bichat are so valued, it is but an act of justice to acknowledge the obligations of the medical student to those who have translated them. It is due to the taste and talents of Doctor Tobias Watkins, to announce him as the first who engaged in that undertaking. He gave a fine translation of the work on Life and Death. The treatise on the membranes was translated by Doctor

Coffin of Boston, and published in 1813. The general anatomy has been faithfully rendered into our language by Doctor Hayward, of Boston. He has displayed not less talent than persevering industry in laying before the profession what has been termed, I believe by Professor Chapman, "a revelation in medicine." By the same pen Beclard's additions have been translated; and to Mr. Togno, a student of medicine, we are indebted for the translation of the posthumous work on Pathology.

I have adhered closely to the works of Bichat. Scarcely a remark has been made which does not rest with him, for I neither designed nor desired to assume responsibility. The few observations on pathology have been presented principally to introduce those truths which have resulted from investigations into general anatomy, or which are not familiarly contained in the books on practical medicine, or the mere mention of which is calculated to lead to important reflection.

I intended to preface this work with a biographical sketch of Bichat. I shall reserve it for another opportunity. Yet it may be appropriate just to say, that he was born in France in 1771—his scholastic pursuits were at Lyons—he there commenced professional studies under Petit—they were continued in Paris under Desault—in 1797 he gave his first course of lectures—indebted to Pinel for the first impulse, he originated and highly perfected the science of general anatomy—he continued to lecture till 1802, when, in consequence of a fall, he contracted a cephalic form of fever, which ended the life and labours of a man, who, at the age of thirty-one, had accomplished works which will be as lasting as the science they have improved.

Six hundred pupils followed the remains of their highly revered preceptor to the grave.



## AN EPITOME, &c.



### GENERAL OBSERVATIONS.

*Of the Physiological and Physical Sciences, and the Properties which preside over their Phenomena.*

*Q.* How are the sciences divided?

*A.* Into the physiological and physical.

*Q.* What do you understand by these terms?

*A.* The physiological sciences are those embracing the philosophy of animate nature. The physical sciences refer to inanimate nature.

*Q.* To what are the phenomena of animate and inanimate nature to be traced?

*A.* To the operation of *vital* and *non-vital* properties.

*Q.* What classes of objects possess *vital* properties?

*A.* Animals and vegetables.

*Q.* In what department of nature do you find the *non-vital* properties?

*A.* In the physical world.

*Q.* What are the *vital* properties?

*A.* Sensibility and contractility.

*Q.* Name some of the non-vital properties.

*A.* Gravity, elasticity and affinity.

*Characters of the Vital Properties compared with those of the Physical.*

*Q.* The characteristics of the *vital* and *physical* properties in animate and inanimate nature are strikingly different; in what principally consists this difference?

*A.* The *physical* are determinate and invariable; the *vital* vary with every day and person. Attraction and gravity are always the same; sensibility and contractility are ever variant.

*Q.* Is there such a state as disorder of the *physical* properties?

*A.* No. Physiology is to living bodies, what astronomy, hydraulics, &c. are to inert ones. There is nothing in physics analogous to pathology in living bodies.

*Q.* What would be the consequence of variableness in *physical* properties?

*A.* The effect would be the disorganization of nature.

*Q.* Then *physical* laws cannot govern *living* bodies?

*A.* No. In one or two functions there is a combined action of *vital* and *physical* properties; such as the eye and ear. The *vital* powers always preponderate.

*Q.* What difference is observable in the elementary arrangements of living and inanimate bodies?

*A.* Composition and decomposition are constantly changing the elements of living bodies; but the elements of inert bodies remain the same until destroyed.

*Q.* Do animate and inanimate bodies resemble each other in the perpetuity of their properties?

*A.* Not at all. *Vital* properties tending to exhaust themselves, animate bodies but for a limited time; they



reach their acme and decline. Physical laws and properties exist unimpaired as long as matter remains.

*Q.* Are sympathies found in living or inert bodies?

*A.* Exclusively in the living. If a stone be bruised or broken, the parts do not suffer; but if a living body be injured in a part, the whole may or does sympathize.

*Q.* What are sympathies?

*A.* Unnatural vital forces indirectly excited by remote impressions.\*

*Q.* What properties belong to vegetable life?

*A.* Organic sensibility and insensible organic contractility.

*Q.* What vital properties do animals possess beyond those of vegetables?

*A.* Besides organic sensibility and insensible organic contractility, in animals you find animal sensibility, animal contractility, and sensible organic contractility.

*Q.* What are the diseases of vegetables?

*A.* They have not the nervous affections, nor fevers which arise from exalted animal sensibility, and sensible organic contractility; but they have tumours, exhalations and affections which result from their vital properties above named.

*Q.* Zoophytes manifest a vital property beyond those of vegetables; pray what is it?

*A.* Sensible organic contractility.

*Q.* What are the gradations of properties assigned by Bichat to the three kingdoms?

\* Bichat does not include in this definition *healthy sympathies*; these were formerly denominated by many physiologists, *synergies*. The term sympathy, however, as at present employed, comprises both these classes of phenomena—healthy and morbid sympathies.



*A.* Physical properties to the *mineral*; physical properties, organic sensibility and insensible organic contractility, to the vegetable; and physical properties and all the organic and animal vital properties for the *animal* kingdom.

*Q.* What functions are controlled by organic sensibility and insensible organic contractility?

*A.* Circulation, secretion, absorption, nutrition, exhalation, &c.

*Q.* What diseases arise from these properties?

*A.* Inflammation, purulent formations, induration, resolution, hæmorrhagies, unnatural augmentation or diminution of the secretions, exhalations, increased or diminished absorptions, dropsies, and many others.

*Q.* What functions are governed by sensible organic contractility?

*A.* Digestion, the circulation in the large vessels, the excretion of urine from the bladder, &c.

*Q.* What are the diseases of these functions?

*A.* Vomitings, diarrhœa, irregularities of the heart's action.

*Q.* What functions depend on animal sensibility?

*A.* The external senses, and what are termed by Bichat the internal senses, as hunger and thirst.

*Q.* What diseases arise from alterations of animal sensibility?

*A.* Pain in its various forms, itching, smarting, tickling, and so forth.

*Q.* In what is animal contractility concerned?

*A.* In locomotion and the voice.

*Q.* What is the essence of disease?

*A.* An increase, diminution, modification or alteration of some of the vital properties just named.

Q. What does the treatment of disease imply?

A. A restoration of these properties to a normal state.

Q. Give an illustration of this.

A. In inflammation your object should be to reduce organic sensibility; in dropsy or œdema to increase it. In convulsions you must reduce animal contractility; in palsy increase it.

Q. What remedies act on sensible organic contractility?

A. Emetics and purgatives.

Q. Give examples of medicines which act on general insensible organic contractility.

A. Tonics, and acids.

Q. Do any act on the insensible organic contractility of particular parts?

A. Yes. Nitre in its action on the kidneys; mercury on the salivary glands.

Q. How do remedies act in reducing animal sensibility?

A. By relieving pain in the parts, as by emollients; or by rendering the brain insensible by narcotics.

Q. Are medicines necessarily confined in their operation, to the reduction, increase or modification of any one of the vital properties?

A. No; they often operate on more than one of these.

*Of the Vital Properties and their Phenomena considered in relation to the Solids and Fluids.*

Q. Why is it not unreasonable to suppose that the fluids are destitute of life?

A. Because they never manifest sensibility and contractility as do the solids.



*Q.* What operation of the fluids and solids gives rise to organic sensibility?

*A.* That impression of the fluids on the solids, which is not perceived by the brain, excites organic sensibility.

*Q.* How does organic differ from animal sensibility?

*A.* In this, that animal sensibility is perceived by the brain.

*Q.* What pathological principle do you found on the location of the vital properties in the solids?

*A.* As disease is but an alteration of these forces, and as these forces are found in the solids, therefore diseases are seated primarily in the solids.

*Q.* By what avenues does Bichat suppose the fluids may become so changed as to cause disease?

*A.* By matters absorbed through the lacteals, the lungs, the skin, and through wounded surfaces.

*Q.* How does he divide the fluids?

*A.* Into those destined to composition, and those of decomposition. The first convey the causes of disease.

*Q.* Are sympathetic impressions conveyed or seated in the solids or fluids?

*A.* Always and essentially in the solids.

*Q.* Does Bichat believe in the vitality of the fluids?

*A.* He does, but does not explain it. The blood possesses vital properties greater than those in the chyle.

*Q.* What speculation is founded on the vitality of the fluids?

*A.* That it may influence their motions.



*Of the Properties Independent of Life.*

Q. What are they termed?

A. Properties of texture.

Q. What are they?

A. *Extensibility* and *contractility* of texture.

Q. What do you mean by the *horny hardening*?

A. It is a form of contractility which parts undergo after death, on exposure to heat, acids, &c.

Q. How many kinds of horny hardening are there?

A. Two; the sudden and slow. The first is produced by fire and acids; the second by neutral salts, air, alcohol, &c.

Q. What textures are not susceptible of the sudden horny hardening?

A. The hair, epidermis, and nails.

Q. What textures are most susceptible of it?

A. The fibrous, muscles, tendons, and nerves.

Q. What state is incompatible with slow horny hardening?

A. It cannot take place during life, but the sudden may, as you see in burns.

Q. What destroys both kinds of this hardening?

A. Putrefaction of the texture.

Q. How many kinds of contractility are there?

A. Five.

Q. What do you understand by *animal* contractility?

A. The influence of the nerves on the voluntary muscles.

Q. What is meant by *sensible organic* contractility?

A. The action of the involuntary muscles from stimuli.

*Q.* What is a third kind of contractility?

*A.* The contractility of texture from *want of extension*, as it appears in the muscles, skin, arteries, veins.

*Q.* Where is this contractility of texture obscure?

*A.* In the nerves, bones, and cartilages.

*Q.* What is the fourth kind of contractility?

*A.* The horny hardening.

*Q.* There is yet another contractility?

*A.* Yes, and a very important one; it is the *insensible organic* contractility, which, by oscillation, forms the tonic forces, or tonicity.

### *Of Animal Organization.*

*Q.* On what does the existence of the vital properties depend?

*A.* On organic arrangement, for when organization is destroyed, the vital properties disappear.

*Q.* What are animal bodies composed of?

*A.* An assemblage of organs.

*Q.* What are organs composed of?

*A.* Of several textures.

*Q.* What are the elementary textures?

*A.* Twenty-one in number; the cellular, nervous of animal life, nervous of organic life, arterial, venous, exhalent, absorbent, and glandular, osseous, medullary, cartilaginous, fibrous, fibro-cartilaginous, muscular of animal life, muscular of organic life, mucous, serous, synovial, glandular, dermoid, epidermoid, and the pilous.

*Q.* In what do these textures differ?

*A.* They differ in form; in their organization; in their properties of life, as contractility and sensibility.



Q. How are these organized systems divisible?

A. Into those every where present as a base for all, and this Bichat calls the *generative*; and secondly, into the *insulated*.

Q. Give examples of the generative tissues.

A. The cellular, arterial, venous, exhalent, absorbent, nervous.

Q. What are the insulated textures?

A. Such as the osseous, cartilaginous, fibrous, mucous, serous, &c.

Q. Is this distinction absolute?

A. It is not; but so far true as to be physiologically important.

Q. Which textures exist most generally?

A. The absorbent and exhalent.

Q. Why is this the case?

A. Because nutrition depends on them.

Q. Which texture is next in extent?

A. The cellular.

Q. What tissues are first developed?

A. The generative or general.

Q. What do you mean by the nutritive parenchyma of an organ?

A. The cellular, vascular, and nervous outline of the organ.

Q. What is the nutritive matter of an organ?

A. That which establishes a difference between the organs.

Q. Give examples of this nutritive matter?

A. The phosphate of lime and the gelatine of bones is one instance; the fibrin in the muscles is another.

Q. Where is this nutritive matter deposited?

*A.* In the nutritive parenchyma just mentioned.

*Q.* What is the first aspect of foetal formation?

*A.* It is a mass of the generative tissues, in which each organ has its nutritive parenchyma in form; and in which parenchyma the nutritive matter is gradually deposited, giving specific character to each texture and organ.

*Q.* How is organization enlarged?

*A.* First, by an extension of nutritive parenchyma, and then by a deposition of nutritive matter.

*Q.* In what does the elective power of an organ on the blood consist?

*A.* In the peculiar organic sensibility by which it chooses or rejects appropriate principles of growth in the blood.

*Q.* On what does the theory of secretion exist?

*A.* On the power of the peculiar vital forces, and sensibilities of textures, which select from the blood that which comports with these forces.

*Q.* Why does the body grow for a certain period?

*A.* It depends on the ultimate fact that composition exceeds decomposition.

*Q.* What is Bichat's theory of secretion?

*A.* That the *parenchyma* of *nutrition* is uniform, that the *nutritive* matter is various, and that the parenchyma of nutrition exercises an eclectic power over the blood, selecting materials for the various nutritive substances.

*Q.* What do you mean by the life of a part?

*A.* The properties of the texture which compose the part.

*Q.* What do you understand by disease of an organ?

*A.* Aberration from the normal condition of the vital forces of *one* of the textures of an organ.



*Q.* Is disease confined at first to *one* texture of an organ?

*A.* Yes; an organ is seldom attacked at first in all its tissues.

*Q.* What governs sympathies?

*A.* Principally similarity of texture.

*Q.* Is fever severest in serous or mucous disease?

*A.* In diseases of the serous tissues.

*Q.* How many sets of symptoms are there in inflammation?

*A.* Two; those of the texture, and those of the organ.

*Q.* What influence has texture on the general phenomena of disease?

*A.* It modifies symptoms and duration of disease.

*Q.* Be more explicit in your answer.

*A.* The different textures in disease give different kinds of pain, different degrees of heat, and have a longer or shorter duration. Hence acute and chronic diseases are relative to the vital properties of the textures; as for instance, a serous texture goes through a disease sooner than an osseous tissue.

*Q.* Why are the mucous, serous, and glandular tissues, so much oftener diseased than others?

*A.* Because their functions require great energy in the organic sensibility and insensible organic contractility, and consequently liability to alterations of these, or in other words disease.

*Q.* What is the correct nosological method?

*A.* That of the diseases which affect the several tissues:

*Of the Functions.*

*Q.* What is Bichat's classification of the functions?

*A.* Into those of animal life, those of organic life, and the functions relating to the species.

*Q.* What do you mean by the functions of animal life?

*A.* Those which connect us with external bodies, and are peculiar to animals.

*Q.* What do you understand by the functions of organic life?

*A.* Those which serve for the constant composition and decomposition of our bodies; these are possessed by animals and vegetables; they distinguish between *organic* and *inorganic* substances.

*Q.* What are the *animal* functions?

*A.* The senses, voluntary muscles, the larynx, and the nerves which are the agents in these functions.

*Q.* What is the centre of these?

*A.* The BRAIN.

*Q.* Designate the *organic* functions.

*A.* Digestion, circulation, respiration, exhalation, absorption, secretion, nutrition, calorification. The HEART is the centre of these.

*Q.* What nerves belong to these two sets of functions?

*A.* The cerebral to the *animal*, the ganglionic or great sympathetic to the organic functions.

*Q.* What conspicuous distinction should be drawn between these two sets of functions?

*A.* The sensibility and contractility peculiar to them. There is the animal *sensibility* and animal *contractility*, and there is the organic *sensibility*, the *sensible*



organic *contractility*, and the *insensible* organic contractility.

Q. What was the ancient opinion as to proximate texture.

A. That the cellular was the substratum of all the solids of the body, and the fibre, the base of the cellular was composed of gluten and earthy particles.

Q. What are Beclard's elements of organization?

A. Three; viz. the cellular, the nervous, and muscular fibre.

Q. Are these very distinct?

A. Yes; in form, chemical composition, and vital functions.

Q. What is Meckel's doctrine of organization?

A. That its elementary substance is globular, a coagulable matter, and a union of these.

## OF LIFE.

*Q.* How do you define the term life?

*A.* A principle, the phenomena of which are recognized, the nature of which is concealed; life is the aggregate of the functions which resist death.

*Q.* How is life divided?

*A.* Into two striking modifications, that of animal life, and organic life.

*Q.* What is a conspicuous characteristic of organic life?

*A.* That it exists both in animals and vegetables.

*Q.* Detail the peculiarities of animal life?

*A.* It appertains exclusively to animals. It is the life by which animated, establishes relations with all nature.

*Q.* What are the orders in the functions of animal life?

*A.* The *first* is from the exterior of the body to the brain, and comprises the receptions, transmission, and perception of the impression ending in sensation. The *second* order originates in the brain, where volition, arising from sensation, acts on the locomotive and vocal organs.

*Q.* Continue the analysis of these two orders of the animal functions.

*A.* In the *first* the animal is acted on by external bodies; in the *second* order of functions the animal reacts on these bodies. There is proportion between these two orders; a powerful impression from without produces a reaction correspondently great.

*Q.* What are the orders of the functions of organic life?

*A.* They are two; first, that engaged in the composi-



tion; secondly, that which decomposes the animal: these operations are incessant.

*Q.* What processes are involved in the assimilative functions?

*A.* Digestion, circulation, respiration, and nutrition.

*Q.* What processes are concerned in decomposition?

*A.* Absorption, circulation, exhalation, and secretion form the second order of the functions of organic life.

*Q.* State the relations that the brain and sanguiferous system bear to these animal and organic vital functions.

*A.* As the brain is a central system between external bodily impressions, and the reaction of volition which follows, so does the sanguiferous system sustain a central position, in organic life, between assimilation and decomposition.

#### *Difference between Animal and Organic Life.*

*Q.* What is the essential distinction in the organs of animal and organic life?

*A.* In those of animal life there is symmetry; in organic life there is the utmost irregularity.

*Q.* Give examples of these two properties.

*A.* The double organs of vision, of hearing, the hemispheres of the brain, the double sets of nerves, are instances of the symmetry of the organs of animal life. The liver, the heart, the spleen, the intestines are always single and often very irregularly disposed. There is irregularity in the number of lobes composing the right and left lungs: the divisions of the pulmonary artery are unlike each other in several respects. These are a few of the examples of the irregularity in the conformation of the organs of organic life.

Q. Why are the animal functions double?

A. A perpetuation of their existence being essential, the loss of one is supplied by the duplicate.

Q. The animal and organic functions differ in another respect, what is it?

A. In the animal there is harmonious function as well as symmetrical structure; in the organic there is nothing of that. This harmony in the animal functions is essential to concordant sensation.

Q. Give further illustration of this idea of harmony in function.

A. If the two auditory or optic nerves conveyed different impressions, the sensations and actions must consequently be confused. Discordant action of the hemispheres of the brain, must produce similar discrepancy.

Q. But this general principle of harmony in function does not hold good in the action of the right and left sides of the body.

A. It does not; but the superiority of the right arm and hand is the effect of habit.

Q. Of what consequence is irregularity in organic life?

A. You will infer its unimportance from the fact, that one kidney may separate more urine than the other; that one lung may admit more venous or eject more arterial blood than the other; that more organic action may exist in one salivary gland than another; that one side of the spleen, pancreas, or liver may receive more blood than another, and yet the organic action maintain its integrity and regularity.

Q. You have already given some of the distinctions between animal and organic life; there are others, and will you state one?



*A.* An important one is, that animal life is intermittent in its functional actions, whereas organic life is perpetually active from birth to death.

*Q.* Can you exemplify the preceding answer?

*A.* The functions of the brain are suspended in sleep, but those of the heart continue. Muscular action is exhausted by fatigue, but secretion, absorption, and exhalation continue uninterruptedly.

*Q.* What does a complete intermission of the action of animal life denote?

*A.* It denotes perfect sleep. This sleep is more or less complete, as the functions of animal life are one or all involved in this intermission; particularly as the senses shall, one or all, have intermitted their connexion with external objects.

*Q.* How do you account for dreaming?

*A.* It is the escape of one part of animal life from the torpidness which pervades the rest.

*Q.* There is yet another respect in which the animal and organic functions differ, what is it?

*A.* Impressions on animal life are ever variant, and they lose their effect from habit; whereas organic life is regularly under the impression of uniform and accustomed stimuli, which do not lose their power from habitual action.

*Q.* Where are the intellectual faculties and the passions located?

*A.* The intellect appertains to animal life, the passions originate in organic life.

*Q.* How is it that organic life is the seat of the passions, if these result from perception and impression on the brain?

*A.* The nerves and brain serve merely as conductors to the impressions which excite passions by irritating organic life. The brain arrests the impressions that excite intellect, but it conducts the passions to organic life.

*Q.* Will you name some of the effects of the passions on our organs?

*A.* Anger hurries the action of the heart; joy does so to some extent: terror enfeebles the energy of the heart, so that blood is not sent to the capillaries. These passions act so intensely on the source of the circulation, as sometimes to stop the action of the heart, producing syncope. Sorrow affects the respiratory organs. The passions variously influence the stomach, spleen, intestines, liver, and even the blood-vessels, so as to occasion lesions in them. Exhalation, absorption, nutrition are less influenced by the passions. Now, observe, that under all these alterations of organic life by the passions, the animal functions are unhurt.

*Q.* But if organic life is the seat and source of the passions, how is it that these passions so excite the organs of animal life?

*A.* As some of the passions increase the heart's action, it follows that an increased volume of blood is sent to the brain; thus the centre of animal life is excited, and the functions dependent on it are exalted. So likewise in those passions which enfeeble the heart's action, the impetus of blood being lessened, the functions of animal life are, by the diminished energy of its centre, debilitated.

*Q.* Is there a common epigastric centre for the passions?

*A.* There is not. The impulse of passion arises in different persons, under different circumstances, from different passions, involving different abdominal organs.



*Q.* Is the term sympathetic nerve, as it is commonly used, a correct one?

*A.* It is not. The ganglions give rise to what is called the sympathetic nerve, not the nerve to the ganglions.

#### OF THE PROPERTIES OF ANIMATED BEINGS.

*Q.* How are these properties divided?

*A.* Into the properties of life, and those of texture.

##### 1. *Vital Properties.*

*Q.* What are these?

*A.* Sensibility and contractility.

*Q.* How is sensibility divided?

*A.* Into animal and organic sensibility.

*Q.* What is the great distinction between organic and animal sensibility?

*A.* In the first, the organ exhibits the faculty of receiving an impression, without transmitting it to a common centre; animal sensibility implies not only the reception of an organic impression, but the transmission of that impression to a common centre, and that centre is the brain. This transmission and cerebral impression constitute the difference between organic and animal sensibility.

*Q.* What phenomena are supported by organic sensibility?

*A.* Digestion, circulation, secretion, exhalation, absorption, nutrition, and others. This sensibility is common to the plant, the zoophyte, and the most perfect animal.

*Q.* What phenomena depend on animal sensibility?

*A.* Sensation, perception, volition, intellect, pleasure,

pain. Now, this sensibility is not the attribute of vegetables.

*Q.* In what respects do organic and animal sensibility resemble each other?

*A.* They originate from the same principle, viz. that of life; and they vary only in degree of exaltation. Hence organic sensibility can, by irritation, be exalted into animal sensibility.

*Q.* Does organic sensibility vary in its nature?

*A.* It does not; it varies in force. In disease it is increased or diminished. In health, each organ has its primitive determinate quantum of sensibility, which places it in relation to its appropriate stimulus, as the urine to the bladder, the air to the lungs. The organs in health will admit no other than their appropriate stimuli.

*Q.* Can you illustrate this more clearly?

*A.* In the healthy state, serous exhalants carry *serum* only, but let their organic sensibility be exalted into animal by irritation, and you will see them allowing the passage of *blood*. This change is often independent of the healthy calibre of the vessels; for a vessel large enough in health to convey a red globule, will, from its organic sensibility, be in relation only to white fluids.

*Q.* What effect has sudden death on these two kinds of sensibility?

*A.* It annihilates immediately the animal, but more slowly the organic sensibility.

*Q.* How is contractility divided and subdivided?

*A.* It is divided into animal and organic contractility. The last is subdivided into sensible and insensible organic contractility.

*Q.* What do you understand by the term contractility?



*A.* It is spontaneous motility, (*motilité*,) an inherent faculty of living bodies.

*Q.* What features serve to distinguish the two kinds of contractility from each other?

*A.* Animal contractility has its impulse from the brain, submits to the influence of the will, ceases when the communication of the organ with the brain is cut off, has its seat in what are called the voluntary muscles, and presides over locomotion and the voice.

*Q.* Place organic contractility in contrast with the animal.

*A.* It has no common centre, such as the brain is to animal contractility; it is uncontrolled by the will; finds its principle in each contracting or moving organ; and presides over the digestive, secretory, absorbent, exhaling, and nutritive phenomena.

*Q.* What effects have *sudden* death and disease on these contractilities?

*A.* This death suddenly destroys animal contractility, the organic remaining larger in existence. The effects of disease may be seen in paralysis, where animal contractility is lost, while the organic remains.

*Q.* What connexion have these contractilities with their respective sensibilities?

*A.* They arise from them, depend on them, inasmuch as action is the result of sensation.

*Q.* Is there not a difference in the relation of the two to their respective sensibilities?

*A.* There is; for the excitement of animal sensibility does not necessarily induce animal contractility. For instance, an impression made on a limb or set of muscles, does not necessarily induce the motion of that member

or of those muscles. But organic contractility always follows the excitement of organic sensibility; this is exemplified in the action of the heart from the stimulus of the blood.

*Q.* How do you explain this difference in the connexion of the two sensibilities and contractilities?

*A.* In animal life there is an intermediate power, the brain, which may, or may not, at pleasure, follow animal sensibility with corresponding contractility: we speak now of the normal state of these parts. In organic life, there is no such intermediate, controlling power; for the stimulus to the organic sensibility, the blood for instance, immediately acts on the contractility of the heart, and excites it to action.

*Q.* Repeat the division of organic contractility.

*A.* Its forms are sensible organic and insensible organic contractility.

*Q.* Can you give examples of sensible organic contractility?

*A.* You perceive it in the motion of the heart, in the contractions of the stomach, especially in the act of vomiting; it is likewise sensible in the intestines.

*Q.* What will exemplify insensible organic contractility?

*A.* The power by which the excretory vessels act on their respective fluids, that by which the secretory organs act on the blood which finds access into them, that which the lymphatics exercise on the substances exposed to their extremities; these are all by virtue of insensible organic contractility.

*Q.* How does sensible organic contractility differ from animal contractility?



*A.* Sensible organic contractility is involuntary, animal contractility in its ordinary condition involves volition.

*Q.* Be more particular in distinguishing sensible and insensible organic contractility from each other.

*A.* Uterine contraction, the heart's action, and vomiting, are instances of *sensible* organic contractility; they can be *felt*. The action of the biliary vessels, indeed of the capillaries generally, are examples of *insensible* organic contractility; they cannot be *felt*. Yet organic contractility, whether sensible or insensible, is the same principle in different degrees of exaltation. The fact that insensible organic contractility is without the sphere of volition distinguishes it from animal contractility.

*Q.* There yet remains a difference between organic contractility and organic sensibility, yet to be stated; it is singular and important, what is it?

*A.* You have seen that a mere exaltation of organic sensibility from disease, will convert it into animal sensibility or pain; now organic contractility, sensible or insensible, cannot be converted or exalted to animal contractility.

*Q.* Should contractility be considered as exclusively attached to the muscular tissue?

*A.* It should not—it is a property of all the tissues to a greater or less extent.

*Q.* What do the two forms of organic contractility represent?

*A.* The sensible organic contractility is the *irritability*, and the insensible organic contractility is the *tonicity* of writers.

## 2. *Properties of Texture.*

*Q.* What are these?

*A.* They are extensibility and contractility of tissue.

*Q.* Can you offer some examples of extensibility of texture?

*A.* The walls of the abdomen extended by tumours, serous infiltrations, or pregnancy; the extension of the tunica vaginalis in dropsy; that of a part filled with abscess. All this is extensibility of texture, a property independent of life.

*Q.* On what do these textural properties depend?

*A.* They depend on the arrangement of the organic fibres of parts; where these fibres are loose, there is much extensibility, as in the muscles, and vice versa.

*Q.* What organs are most extensible?

*A.* The muscles, skin, and cellular tissue; those least so, are the bones, cartilages, tendons, nails, &c.

*Q.* How can you exemplify contractility of texture?

*A.* After distending causes have been removed, you see parts return to their natural state. It is exhibited in the contraction of the abdominal parietes after delivery, or on the evacuation of peritoneal dropsy. It appears again when the stomach or bowels, after great distention with wind, resume their wonted dimensions.

*Q.* Is this contractility of texture greater in the dead or living parts?

*A.* Although these properties of texture are independent of life, yet this imparts to them additional force.

*Q.* Present an example of a part possessing all the various forms of contractility.



*A.* A muscle will exemplify this best. Thus, 1st, cerebral impulse conveyed through the nerves, occasions a contractility; this is *animal contractility*, and is *voluntary*; 2d, on the application of a strong stimulant, there will be a muscular motion, which is *sensible organic contractility*, or irritability; this is *involuntary*; 3dly, a penetration of all the parts of the muscle by its nutritive fluids, developes a movement of oscillation, which is *insensible organic contractility* or tonicity, and this is *involuntary*; 4thly, cut across a muscle and its fibres retract; this is the *contractility of texture*; lastly, various organs possess one or more of these forms of contractility.

*Q.* What form of contractility is possessed by all living parts?

*A.* Insensible organic contractility or tonicity.

*Q.* Name that contractility which is the attribute of all parts, living or dead?

*A.* All tissues, whether living or dead, possess contractility of *texture*.

*Q.* Can you give a tabular recapitulation of the properties of living bodies?

*A.* The general division is into vital and textural properties.

#### Vital Properties.

A. Sensibility—the faculty which an organ feels.

*a.* *Animal* sensibility; in which the sensation is felt by the organ, and conveyed to the brain.

*b.* *Organic* sensibility; in which the organ feels, but the sensation is not conveyed to the brain.

B. Contractility—the faculty by which motion voluntary or involuntary takes place.

*a.* Animal contractility—voluntary.

*b.* Organic contractility—involuntary.

Organic contractility is divided into—

1. *Sensible* organic contractility; as the motion of the heart, contractions of the stomach, &c.—these are *sensible*, but involuntary.
2. *Insensible* organic contractility; as capillary action or motion: this is *insensible*, and involuntary.

Properties of Texture.

A. Extensibility.

B. Contractility.

*Q.* What composes the life of the organs?

*A.* A modification of the above mentioned vital properties, which control the circulation and temperature of each organ.

## OF ANIMAL LIFE.

*Q.* What is the first conspicuous distinction between animal and organic life?

*A.* The period of the commencement of the two lives. Organic life commences with the rudiment of fœtal life; animal life begins after birth.

*Q.* Why do you say that animal life is quiescent before birth?

*A.* None of the senses being in exercise, the fœtus does not feel; there is neither sensation, perception, nor volition. It is not probable that the liquor amnii causes any sensation.

*Q.* Is it true that the surrounding temperature, and the liquor amnii, are the only external objects capable of exciting sensation in the fœtus?

*A.* The contact of the uterus may be admitted as a fee-



ble cause. From all that has been ascertained it may be inferred that the senses are not in action in the foetus, especially the touch.

*Q.* One attribute of animal life certainly exists in the foetus, if the senses do not, what is it?

*A.* Locomotion does truly exist, but that of the foetus, is not the consequence of external sensation or of animal life. It results from the brain being sympathetically stimulated, by the organs of organic life, in their foetal development. The locomotion exists, it is involuntary. For example, the foetal heart sends undue measure of blood to the brain; it is thereby excited, and thus involuntary muscular action is induced. Now compare this with voluntary locomotion in independent life, in which sensation, perception, and volition concur.

*Q.* There is another feature distinguishing animal from organic life, what is it?

*A.* The operations of organic life are perfect at birth; those of animal life become so only in process of education and habitual exercise. The senses of the infant trace, at first, confused general images; so do the perceptions; the intellectual operations are latest in attaining perfection.

*Q.* What are the laws governing this education of the functions of animal life?

*A.* Let it suffice to state one. The improvement or perfection of any one of these is at the expense of others; that of the memory at the cost of judgment, &c. The perfection of one sense is at the expense of another. Now it is curious, that the operations, not the education, of organic life are under the influence of a similar law: the excessive action of one organ is at the expense of another.

## OF ORGANIC LIFE.

Q. What organ in this system is first developed?

A. The heart, the *punctum saliens*.

Q. What is the difference between foetal organic and independent organic life?

A. The difference is great as to the number of functions in operation. For instance, in the foetus there is little assimilation, because the blood comes prepared from the mother; there is neither digestion nor respiration; there is no excretion. In after life all these functions are in play. In foetal organic life there is rapid assimilation, but slow and slight decomposition.

Q. On what does the perfect operation of organic life depend?

A. Not on education, nor on habit, nor on symmetrical arrangement as in animal life, but on original structure or organization.

Q. Where is the moral character seated?

A. The passions constituting this, are seated in *organic* life!

Q. In natural death, which life, animal or organic, dies first?

A. Animal life does. The senses give way; the skin becomes tough, and hard, and being deprived of much of its vascularity, it is the seat of obscure touch. As sensation is blunted, the mental faculties decline; that declension weakens volition; the voluntary muscles are disused; thus the organs of animal life die in detail. Organic life fails in the same gradual manner; digestion, secretion and absorption decline or cease; the capillary circulation from the loss of tonicity is embarrassed; the general circulation ceases, and the heart ultimately dies. Such is the natural death of the old man.



## ON DEATH.

*Q.* Is the dependence of animal life on organic, or that of organic life on animal, greatest?

*A.* Intimately as they are related, it is to be observed, that death of the animal organs, instantly follows that of the organic; whereas organic life continues some time after animal life has ceased.

*Q.* What is the sure indication of complete death?

*A.* The termination of the functions or phenomena of organic life.

*Q.* What triple alliance is necessary to life?

*A.* The functions of the heart, lungs and brain.

### *On the Influence of the Death of the Heart upon that of the Brain.*

*Q.* How does the heart influence the brain?

*A.* Through the circulation of the blood, and by nervous transmissions.

*Q.* How does the circulation of red blood influence the brain?

*A.* In two ways: by the motion of the blood in the arteries; and by the intrinsic qualities of red blood, vivifying they may be called. Too great motion of the brain from the heart's action, or too little will morbidly excite or debilitate the cephalic functions.

*Q.* In injection of air into the veins, where is its fatal impression made?

*A.* On the brain, for the heart continues to live after animal life is destroyed.

*On the Influence of the Death of the Heart upon that of the Lungs.*

*Q.* What constitutes the functions of the lungs?

*A.* Two processes; first, the mechanical one of expansion by the aid of the muscles, and the chemical one of changing the black blood to red.

*Q.* In cases where the heart with black blood ceases to operate, how are the lungs interrupted?

*A.* There is no blood in the lungs in this case; the brain is indirectly affected, because the heart, receiving no red blood from the lungs, sends none to the brain. Without this red blood the brain is unable to maintain the action of the ribs and intercostals, so the mechanical function of the lung ceases.

*Q.* How are the lungs affected, when the red blood heart, is interrupted in its functions?

*A.* The operation is an indirect one through the brain; thus, the brain receives no red blood, consequently it communicates no power to the intercostals and diaphragm; and the lungs cease to live in consequence of a suspension of their mechanical functions.

*On the Influence of the Death of the Heart upon that of the Organs generally.*

*Q.* How is the death of the organs generally, induced by that of the heart with red blood?

*A.* The organs of animal life die, because the heart sends



no red blood to the brain. The organs of organic life cease, because the arterial movement is extinct, and because they have not the excitement of red blood.

*Q.* Explain this motion or arterial impulse which you say is so important?

*A.* Habitual movement is alike essential to animal as well as organic life; without it they all languish. You see muscular motion; the motion given to the brain by the pulsation of the arteries; the movement of the thoracic viscera in respiration and that of the heart; and in the abdominal organs there is the pulsation of the arteries, the capillary and oscillatory motions, the contractions and dilatations of the stomach and bowels. You observe how conspicuous a share in the general motion, arterial impulse has; now in the death of the red blood heart, it is extinct.

*Q.* Has not the death of the red blood heart, an indirect effect in inducing general death?

*A.* Yes—it does so through the medium of the brain.

*Q.* Is there any relation between the quantity of blood conveyed to a part and the vital forces of that part?

*A.* A very important one; the vital forces are exalted or diminished as the quantity of blood sent to an organ is increased or diminished.

### *On the Influence of the Death of the Heart on General Death.*

*Q.* Can you trace the influence of the death of the heart in the production of general death?

*A.* The death of the heart arrests the impulse of blood on the brain, and thus animal life is first extinguished. This influence on the brain is of two kinds; first, the mo-

tion given to the brain by arterial action; secondly, the vivifying power of red blood. The cessation of the same impulses on organic life induces death in that system, in which organic sensibility and insensible organic contractility are last to die. Death in the heart then is felt, first in the death of the animal, and secondly in that of the organic system of life.

*Q.* Why do the vital forces continue longer in organic than animal life?

*A.* Animal life having but one common centre, the brain, the death of that is followed simultaneously by that of all its dependencies. In organic life there being many ganglionic centres, life is there kept up longer.

*Q.* Where does death from mental emotion first take place?

*A.* It takes place first in the heart.

*Q.* What organ is primarily affected in syncope?

*A.* The heart always.

*Q.* What reasons do you assign for this theory of syncope?

*A.* The passions affect organic life primarily, and not animal life; the phenomena of syncope are the same whether produced by the passions, by cardiac obstructions, or by hæmorrhage; in the approach of syncope the sensation is first felt in the heart; the heart is diseased by the passions, while the brain is not; the heart has direct influence over the brain, while cerebral influence on the heart is indirect, for the heart continues to live some time after the brain dies, whereas the brain dies instantly on the death of the heart; lastly, palpitations and other impressions on the heart proceed from the same causes which induce syncope.



Q. There is a great difference in the mode by which asphyxia, syncope, and apoplexy induce death, what is it?

A. In asphyxia death commences in the lungs, in syncope in the heart, in apoplexy in the brain.

*On the Influence of Death of the Lungs upon that of the Heart.*

Q. In diseases, where does death usually commence?

A. In the lungs.

Q. In syncope, what is the condition of the lungs?

A. They are empty and collapsed, because the heart failing suddenly, blood is not thrown into them.

Q. Repeat the mode in which death takes place in the lungs?

A. By the cessation of its *mechanical* and *chemical* functions.

Q. What causes affect the mechanical functions of the lungs?

A. A wound which exposes the lungs in both cavities; such a section of the spinal marrow as cuts off the intercostal and phrenic nerves from cerebral influence; the sudden introduction of a large quantity of fluid into the cavities of the thorax, &c.

Q. How are the chemical functions of the lungs destroyed?

A. By asphyxia, strangulation, submersion, or a vacuum however produced.

Q. How does an interruption to the mechanical functions of the lungs affect the heart?

A. The collapse of the lungs mechanically obstructs the circulation of the blood from the right side of the

heart; and the lungs do not transmit red blood to the heart.

*Q.* How does a cessation of the chemical function of the lungs affect the heart?

*A.* It is by the operation of black blood on the vital forces of the heart. Understand, it is not contact of black blood with the lining membrane of the heart, but because black blood conveyed to the heart through the coronary arteries fails to maintain its vital forces.

*Q.* How does black blood destroy life in the organs generally?

*A.* By its contact with the minute fibres, &c. of the organs, and not by impression made on the internal surface of the heart.

*Q.* Is this operation of black blood on the minute fibres, or on the nerves which supply them?

*A.* It may be on the nerves.

*Q.* Why does the left side of the heart always die first?

*A.* Because its supply of blood fails soonest; for as death progresses the blood accumulates in the right side of the heart, keeping it alive longest.

*Q.* Why are the right heart and the veins always more loaded with blood in asphyxia, than the red blood heart and arteries?

*A.* Three causes concur to produce this; viz. the kind of blood in circulation, the state of the lungs, and that of the heart.

*Q.* What agency has the blood in inducing this loaded state of the right side of the heart and of the veins?

*A.* In asphyxia the heart circulates black blood; this being unfit for secretions, exhalations and nutrition, is not consumed for the purposes of the œconomy, it therefore



passes directly to the veins from the arteries and fills them.

*Q.* Did you not say that the lungs contributed to this fulness of the right heart and veins in asphyxia?

*A.* The passage of blood from the right heart to the lungs, is impeded by the weakness of their chemical function; this weakness arising from the circulation of black blood, in the bronchial arteries in asphyxia. This state of the lungs, stagnates blood in the right or black blood side of the heart.

*Q.* The third cause for this collection of blood in the right heart and veins was the condition of the heart itself, explain this?

*A.* The powers of the right auricle and ventricle are debilitated by the collection of blood in them from the two causes above assigned; this debility still further favours the congestion in the large veins near the heart.

*Q.* Why does the vascular system with red blood, contain so little of that fluid in asphyxia?

*A.* Because the obstruction in the lungs prevents the flow of blood to the aortic side of the heart, and because the arteries empty themselves by their inherent powers, into the veins.

*Q.* How is the lividity of parts in asphyxia to be accounted for?

*A.* It has been attributed to reflected venous blood; it is, however, owing to the fact that in asphyxia the heart circulates black blood.

*On the Influence of the Death of the Lungs upon that of the Brain.*

*Q.* How does death of the lungs influence that of the brain in asphyxia?

*A.* In the death of the lungs the failure of their chemical functions sends black blood to the heart; the heart sending it to the brain, the latter penetrated by black blood, dies.

*Q.* Some curious experiments confirm this deleterious action of black blood on the brain, what are they?

*A.* *Arterial* blood from the carotid of one dog, was thrown into the carotid of another dog which had a ligature next to the heart; the animal lived. *Venous* or black blood was then used in the experiment, and the dog was killed at once. The black blood did not excite the brain, or was poisonous to it.

*Q.* Is not the death in the case above stated owing to the want of pulsation or arterial motion in the brain?

*A.* It is not; because, in the process of asphyxia in animals, the aorta *pulsates* black blood into the brain; in this then, there was no want of cerebral motion from the blood.

*Q.* On what part does asphyxia first produce death?

*A.* On the brain; animal life first suffers. Those who have escaped suffocation complain of drowsiness, a general numbness, head-ache, paralysis, even convulsion, all evidently seated in the brain.



*On the Influence of the Death of the Lungs upon that of the Organs generally.*

*Q.* How do you ascertain the progress of asphyxia in animals?

*A.* Tie the trachea high up; make an opening below the ligature, introduce a tube with a cock to it. By this means you can admit air as you please to the lungs. Adapt a small tube and cock to the crural artery, and by this you ascertain the state of the blood in the progress of the asphyxia.

*Q.* If the cock of the pipe be shut immediately after *inspiration*, what changes are made in the blood?

*A.* In thirty seconds the blood begins to darken; in a minute its colour is deepened; in two minutes it is black blood.

*Q.* What is the effect of stopping the cock after a strong expiration?

*A.* The blood becomes sooner black.

*Q.* What takes place when you pump the air from the lungs with a syringe?

*A.* The blood blackens immediately; the crural artery throws a black stream, as soon as the red blood which it contained can be emptied.

*Q.* And what if the air cells are completely filled before the cock is stopped?

*A.* The blood is slower in becoming black.

*Q.* After asphyxia has been established for some minutes, if the stop be opened, what takes place?

*A.* A strong expiration first takes place; then several deep rapid respirations, and an instantaneous, not gradual restoration of the blood to a red colour. These changes

are more or less complete according to the quantity of air admitted.

*Q.* From the rapidity with which the blood is reddened, what do you suppose to be the course of the colouring principle?

*A.* There can be little doubt that the colouring matter passes the membranes of the air cells to the blood, and not through the absorbents.

*Q.* When asphyxia is removed by the introduction of air, how is the heart affected?

*A.* Red blood is sent to the left heart, it penetrates the coronary arteries, and reanimates the forces of the heart, which were exhausted by the black blood.

*Q.* If the heart's action is once entirely checked, can it be restored by the injection of air into the lungs?

*A.* It cannot. The heart having ceased to beat, the coronary arteries no longer nourish the vital forces of the heart with blood. A temporary syncope may be removed.

*Q.* What are the symptoms in asphyxia from hydrogen and carbonic acid gas?

*A.* After a hurried, agitated, embarrassed respiration for a few minutes, the blood becomes black.

*Q.* Why is the blood longer in blackening when these gases are respired?

*A.* The expelled and reabsorbed air in this process, affords all its vivifying principles to the blood. But when the tube and cock are simply shut, there is not this agitation of the respirable air remaining in the lungs.

*Q.* If oxygen be respired, what occurs?

*A.* The blood is much longer in losing its red colour.

*Q.* How do you prove that black blood is circulated in the organs in asphyxia?



*A.* By the fact, that the left heart does act for some time after black blood is thrown into it; which of itself proves that it must throw black blood into the organs.

*Q.* Is there not other evidence of the injection of the organs with black blood in asphyxia?

*A.* Dissection has given beautiful evidence of it in the muscles. In them you see the black drops of blood oozing from the vessels of the cut muscle, while the colouring matter of the muscular fibre preserves them red. Again, this black blood is seen in the arteries of the nerves. It is stagnant in the skin, because the black blood does not sufficiently excite the capillary circulation to action. The passage of black blood into the mucous and serous membranes is clearly evidenced by exposing these tissues, and shutting the stop-cock in the trachea.

*Q.* What phenomena are accounted for by the left heart circulating black blood?

*A.* Besides explaining many other pathological facts, it accounts for the existence of black blood in the arteries after death; it likewise explains the darkness of the mucous membranes after death.

*Q.* What effect has the black blood on the tissues?

*A.* Defective in exciting power, the vital forces of the organs penetrated by black blood diminish; this is from a destruction of their own vital forces that the organs suffer, not from direct dependence on the heart or brain. The destruction of organic life is an independent process, as that of animal life, connected as the two may be.

*Q.* What effect has asphyxia on the white organs, or those to which no blood is ordinarily sent?

*A.* The question cannot be answered.

*On the Influence of Death of the Brain on general Death.*

*Q.* Will you state precisely the order in which death progresses, when the mechanical function of the lungs is interrupted?

*A.* First, the mechanical phenomena, then the chemical fail from want of air; next the cerebral action from want of red blood excitement; then animal life, sensation, locomotion, and the voice, from the loss of cerebral action and red blood; then the general circulation; next the capillary circulation, from the want of action excited by red blood in secretion, absorption, exhalation; lastly, digestion fails. This is the order of death on loss of the mechanical function of the lungs.

*Q.* Now give the order in which death supervenes when the chemical function of the lungs ceases?

*A.* 1st, Interruption of the chemical phenomena; 2d, Necessary subsequent suspension of cerebral action; 3d, Cessation of sensation, of voluntary locomotion, of the voice, and mechanical phenomena of respiration; 4th, Annihilation of the heart's action, and of the general circulation; 5th, Termination of the capillary circulation, of the secretions, of exhalation, absorption, and consequently of digestion; 6th, Cessation of animal heat, which is the result of all the functions. This is the progress of death, when the chemical functions of the lungs cease.

*Q.* How do asphyxiæ vary?

*A.* The process is slow or rapid; the subject is convulsed or calm.

*Q.* What gases produce asphyxia most speedily?



*A.* Sulphuretted hydrogen, nitrous gas, effluviæ from privies produce it more speedily than other gases, or than a vacuum does.

*Q.* How do you divide asphyxiæ?

*A.* Into those produced by want of air, and those from poisonous gases. In the first, death is produced by the circulation of black blood purely; in the second there is added to the black blood a deleterious substance. In some cases death is produced by the poisonous effluviæ alone.

*Q.* There are two modes by which deleterious gases affect the lungs, what are they?

*A.* They affect the nerves of the lungs, and these react by sympathy on the brain; and they pass into the blood, and thus likewise exert a morbid influence on the brain and organs in general. Simple contact of a deleterious gas with a mucous surface does not produce death immediately.

*Q.* Is it certain that air will pass through the membrane lining the bronchiæ, into the blood-vessels?

*A.* It is rendered certain by direct and analogical proof. Experiments on animals show that a quantity of air enters the blood-vessels, and may be drawn off with the blood. Hydrogen has been drawn from the arteries, almost as pure as when forced into the blood.

*Q.* On what system, do the deleterious vapours absorbed into the general circulation, in asphyxia, operate?

*A.* On the brain and nerves. The reasons for this opinion are, that the symptoms are stupor and convulsions; that the symptoms are the same when the gases are inhaled, as when injected into the brain; the phenomena, on restoration from this absorption, are cephalic, such as tremors, pain in the head, &c. These all point to the brain as the system on which these deleterious poisons operate.

The contact of black blood with the organs has doubtless some agency in inducing death.

*Q.* In diseases where does death begin?

*A.* In the lungs.

*Q.* What is the colour of the arterial blood after death from disease?

*A.* It is black, because death commencing in the lungs, their chemical functions give way, the blood sent to the left heart is black, and consequently the arterial blood is so too.

*Q.* When death begins in the heart, what is the colour of the arterial blood?

*A.* It is red, and the lungs are empty.

*Q.* When death commences in the brain, what is the condition of the lungs?

*A.* Generally they are empty of blood.

*On the Influence of Death of the Brain upon that of the Lungs.*

*Q.* Does death of the brain affect the lungs directly or indirectly?

*A.* From experiments made in cutting the sympathetic nerve and par vagum, it is presumed that direct cerebral influence does not induce death of the lungs. For although all these nerves be cut, respiration continues for some time; yet surely if direct cerebral influence operates on the lungs it is by these nerves.

*Q.* How then does death of the brain induce that of the lungs?

*A.* Indirectly, by cutting off the cerebral influence, paralyzing the diaphragm and intercostal muscles, and thus destroying the mechanical functions of the lungs.



*Q.* What view then shall we take of respiration?

*A.* Respiration is a common function, serving as a point of contact between the animal and organic lives, attached to the first by its mechanical, and to the second by its chemical functions.

*On the Influence of Death of the Brain upon that of the Heart.*

*Q.* Is the heart directly influenced by the death of the brain?

*A.* The direct influence of the brain is extended only to the voluntary organs; the heart not being an organ of volition, we conclude it is not under direct cerebral influence. Experiments prove the absence of this direct influence.

*Q.* By what intermediate organ does death of the brain act on the heart?

*A.* Through the lungs. There is interruption of the cerebral action; then annihilation of the action of muscles of animal life, consequently a cessation of the mechanical functions of the lungs; next, suspension of the chemical functions, penetration by black blood of the fibres of the heart, and its death.

*Q.* Why is the blood red or black in different surgical operations?

*A.* This depends on the embarrassment of the pulmonary function; when that is very great the chemical functions of the lungs cease, and the blood discharged is black.

*On the Influence of Death of the Brain on the organs generally.*

*Q.* How does the death of the brain affect that of all the organs?

*A.* The organs of animal life die directly, because of their immediate dependence on the brain.

*Q.* But is not the influence on organic life equally direct?

*A.* Evidently not; the phenomena of disease, and experiment, prove it. These experiments show that the brain exercises only indirect influence on organic life. The death of the brain destroying the mechanical function of the lungs, the chemical functions also cease, causing thereby the penetration of organic parts with black blood; this overwhelms them, and they die.

*On the Influence of Death of the Brain on general Death.*

*Q.* State distinctly the successive phenomena produced on the body in general by death of the brain.

*A.* There is death of the brain, of animal life; cessation of the mechanical functions of the lungs; cessation of the chemical functions of the lungs; black blood in the arteries; death of the heart; death of organic life; cessation of the capillary circulation; destruction of animal heat, as well as that of the life of the white organs.



## OF THE CELLULAR SYSTEM.

*Q.* Give a definition of the cellular tissue.

*A.* It is composed of an assemblage of filaments, and soft, whitish laminae interwoven and intersecting each other in various ways, with very irregular communicating spaces, forming reservoirs for the fatty and serous fluids.

*Q.* What relations does this texture bear to the several organs?

*A.* It surrounds, separates, and connects them; and continuing to their interior structure, it enters universally into their composition.

*Q.* Define more particularly the relations of this texture to the exterior of the various organs.

*A.* There are organs which have one surface free, the other adherent; the cellular texture is connected only with the adherent side of these organs. There are other parts entirely surrounded by neighbouring organs; the cellular texture entirely surrounds these.

*Q.* Which are the organs with a free and an adherent surface?

*A.* The skin, the serous and mucous membranes.

### *Of the Sub-cutaneous Cellular Texture.*

*Q.* At what part is the cellular texture most adherent to the skin?

*A.* At what is termed the median line of the body; viz. the middle of the nose, lips, sternum, and linea alba.

Q. Where is this sub-cutaneous texture most dense?

A. On the scalp; on the palmar and plantar surfaces, and at the annular ligaments.

Q. Why is this texture loose, as in the face and on the abdomen, and dense elsewhere?

A. To favour the functions of parts, where looseness avails some, and density others.

Q. How does the density of cellular structure affect dropsical and emphysematous swellings?

A. Where it is dense, there is neither a collection of water nor air.

Q. When is this density of cellular structure at the annular ligaments most observable?

A. In infants, and in very fat persons.

Q. What are the uses of the sub-cutaneous cellular texture?

A. It allows mobility to the skin, facility to the motions of subjacent parts, and it serves to defend from cold. It is more abundant in winter than in summer, and it is found in greater quantity in animals inhabiting cold climates. Recollect the chilliness which accompanies attenuation in chronic diseases.

Q. In what part of the cellular texture does serum most readily accumulate?

A. In the sub-cutaneous portion, and in this, because of its laxity.

#### *Of the Sub-mucous Cellular Texture.*

Q. What is the great difference between the sub-mucous and the sub-cutaneous cellular textures?

A. The sub-mucous is much more dense in its whole expansion.



*Q.* What would be the consequence of a loose sub-mucous cellular texture?

*A.* Dropsy would form in a loose texture, and the hollow organs be closed by their sides being pressed into contact.

*Q.* What exempts the sub-mucous cellular texture from emphysema?

*A.* The density of its structure, which prevents gaseous distention.

*Q.* Why is the sub-cutaneous cellular tissue more liable to phlegmon than the sub-mucous?

*A.* Perhaps, because of its laxity of structure, and of its freer exposure to the causes of phlegmonous inflammation.

*Q.* There is yet another important result from the density of the structure of the sub-mucous cellular coat?

*A.* It fits it for giving origin and insertion to the muscular fibres of the hollow organs, such as the stomach, bowels, and bladder.

#### *Of the Sub-serous Cellular Texture.*

*Q.* Is this texture generally loose or dense?

*A.* Remarkably loose; it is liable to serous and emphysematous distention.

*Q.* Why is it thus loose?

*A.* For adaptation to the dilatations and contractions in the serous membranes.

*Q.* Can you give some examples of dense, adherent, serous texture?

*A.* The two layers of the pericardium—the adhesion of the arachnoides to the dura mater are instances.

*Q.* What does this intimate union of the serous and fibrous membranes constitute?

*A.* They form what are called the sero-fibrous membranes.

### *Of the Arterial Cellular Texture.*

*Q.* What are the peculiarities of this texture?

*A.* It is remarkably dense; it is never infiltrated with serum; fat does not accumulate in it; it is rarely found in a state of inflammation.

*Q.* How is this arterial texture formed?

*A.* It is formed by a gradual condensation of the neighbouring cellular texture.

*Q.* Are the arterial fibres implanted in this dense coat, as the muscular fibres of the stomach, &c. are in the sub-mucous cellular tissue?

*A.* No; the arterial cellular tunic adheres too loosely to the vessels to admit that supposition.

### *Of the Venous Cellular Texture.*

*Q.* What characterizes this texture?

*A.* It is not so dense as the arterial, and is more dry. It is not liable to fatty or serous infiltrations.

*Q.* How is the cellular cylinder of the veins and arteries to be distinguished from the nervous filaments and branches?

*A.* The cellular texture is white; the nerves are gray; this is ascertained by deliberate maceration.

*Q.* What other canals have a cellular cylinder?

*A.* The excretory ducts, those of the pancreas, gall-



bladder, &c. If the absorbents did not, by their fineness, preclude demonstration, it would doubtless be found that they have a cellular coat, as well as the blood-vessels.

*Of the Cellular Texture embracing the Organs on all Sides.*

Q. What organs are included here?

A. All except those already mentioned.

Q. What are the effects of this cellular investment?

A. It insulates the several organs; it insulates likewise their vitality; it forms a line of separation between them. It sometimes prevents the extension of disease from one organ to a contiguous one; as when the peritoneum is inflamed without the viscera being affected, or as when the sub-cutaneous organs are healthy, while the skin is in eruption.

Q. Is this the only barrier to the extension of disease in these circumstances?

A. No; the difference in the vital forces of different, though contiguous organs, also prevents the extension of disease.

Q. But does this cellular investment always perform the salutary office of arresting the spreading of diseased action?

A. It does not; for by taking on disease, it facilitates its extension.

Q. Can you illustrate the preceding answer?

A. The extension of tumours, that of phlegmon, and that of rheumatism swelling a joint, are examples.

*Q.* Is there no other influence spread by this cellular atmosphere around the organs?

*A.* Medicinal agency is conveyed by it.

*Q.* Give instances of this.

*A.* The effect of blisters, cataplasms, and other applications may be adduced.

*Q.* How are the vital forces of organs generally injured?

*A.* In three ways: 1st, by direct irritation; 2d, by sympathy; 3d, by *cellular* communication. The last is exemplified in the discolouration and inflammation of the skin over a carious bone.

*Q.* What other physiological office is performed by this cellular investment?

*A.* It facilitates the motion and expansion of organs.

*Q.* What other means have some organs to facilitate their mobility?

*A.* The serous membranes perform this office in many cases.

### *Of the Internal Cellular Structure of the Organs.*

*Q.* What relation does this bear to the several organs?

*A.* It enters intimately into their elementary structure; it surrounds each vessel, nerve and fibre; it insulates each by sheathing it; and it favours the mobility of the fibres and vessels of the organs.

*Q.* Does it partake of the vital properties of the organs?

*A.* It does not; the cellular texture has its own vital properties. It has not the sensibility of the nerve into the structure of which it enters; it has not the contractility of the muscle, nor yet the secretion of the gland.



*Q.* Are its diseases, distinct from those of the organs into which it enters?

*A.* They are. Tumours form in this cellular texture within the organ, or suppuration occurs in it; while, as you will conspicuously see in tumour or abscess of the liver, the secretion of bile will go on. The function of the lungs going on, in the course of extensive disease in them, is another illustration of this principle.

*Q.* How is this cellular texture discovered in some organs?

*A.* Maceration and ebullition will exhibit it.

*Q.* What proves its existence in bones and cartilages?

*A.* The granulations essentially of a cellular nature, which sprout from these in their diseases and injuries.

*Q.* Is there any organ destitute of this internal cellular texture?

*A.* No—it is an essential constituent of the nutritive parenchyma of every organ.

### *Cellular Texture of the Head.*

*Q.* Where do you find, on the head, this texture most abundant?

*A.* In the face; on the cranium there is little.

*Q.* Is there much in the interior of the cranium?

*A.* Very little; a small quantity is found where the vessels go in and out.

*Q.* To what is the redness of the eye in phrenitis ascribed?

*A.* To the cellular communication through the orbit.

*Q.* What occasions the weight and pain in the head in coryza?

*A.* The cellular communication through the cribriform plate of the ethmoid bone, favours the extension of the pain in the head.

*Q.* To what does Bichat ascribe the coup de soleil?

*A.* To the cellular connexion between the external and internal membranes of the cranium through the sutures!!!

*Q.* Why in erysipelas of the scalp do you see the pus and serum in the eyelids?

*A.* Because of the communications of the cellular texture of the cranium with that of the face.

*Of the Cellular Texture of the Trunk and Extremities.*

*Q.* Where is the spinal or vertebral cellular texture principally found?

*A.* There is little found along the spine externally; there is much on the anterior surface of the vertebral column. There is very little in the cavity of the vertebral canal.

*Q.* Where do depositions from the course of the spine sometimes show themselves?

*A.* In the groin, from cellular communications.

*Q.* Where is the cervical cellular texture most abundant?

*A.* In the lateral parts, where the lymphatic glands are. It abounds also about the neck generally.

*Q.* What evidence is there of the communication of the cervical and pectoral cellular textures?

*A.* The extension of emphysema from the lungs to the neck.

*Q.* Where is the pectoral cellular texture principally found?



*A.* In the interval formed by the fold of the mediastinum, about the pericardium, and where the large vessels come out.

*Q.* How does this pectoral texture communicate with the abdominal?

*A.* Through the diaphragmatic openings.

*Q.* Where do you meet with external pectoral texture?

*A.* In great quantities in the breasts of women and men, and under the pectoral muscles.

*Q.* Why has disease of the peritoneum more influence on the right pleura than the left?

*A.* The peritoneum on the right side being kept fixed by the convex surface of the liver, the communications of the abdominal and pectoral cellular textures are there more constant and operative, than where the peritoneum, towards the left pleura, is loose and floating with the viscera.

*Q.* With what has the pectoral cellular texture peculiar relation?

*A.* With the cellular texture of the superior extremities.

*Q.* Where is the abdominal cellular texture most abundant?

*A.* Where the large vessels enter the viscera, and about the kidneys.

*Q.* What are the principal relations and communications of the abdominal cellular texture?

*A.* They are with the genital organs and inferior extremities through the abdominal ring and crural arch. The abdominal cellular texture bears the relation to that of the lower extremities, which the pectoral does to that of the superior.

*Q.* Is the cellular texture abundant in the pelvis?

*A.* Very much so, in order to protect the distending viscera of that cavity.

*Q.* Where is the cellular texture of the superior and inferior extremities principally found?

*A.* Around the scapulo-humeral, and the ilio-femoral articulations.

*Q.* What physiological reason is there for the diminishing quantity of cellular texture towards the extremities?

*A.* That the positive operations of the hands and feet might not be encumbered by it.

*Q.* What is particularly interesting in the cellular texture of the different cavities?

*A.* The communications through the several openings above mentioned, through which inflammation, and serous and other infiltrations are extended.

*Q.* On what does corpulency depend?

*A.* On a preternatural distention of the cells of this texture.

*Q.* Are these cells increased in size as they are full or empty?

*A.* They enlarge to accommodate the fat and serum exhaled.

#### OF THE FORMS OF THE CELLULAR SYSTEM AND OF THE FLUIDS IT CONTAINS.

*Q.* What is the figure of the cells of this texture?

*A.* There is no uniformity in this respect.

*Q.* What proves a universal communication of these cells?

*A.* Such phenomena as these; the extension of emphysema; the emptying of a hydropic limb from one or two



punctures; the ascent and descent of fluids on pressure—these and other facts prove this communication between the cells.

*Q.* By what fluids is this texture exclusively permeable?

*A.* By fat and serum. Fluids do not pass through this texture from the stomach to the skin and bladder, as has been supposed. The vital forces of the cellular texture are only in relation to fat and serum.

*Q.* What part of this texture is destitute of fat?

*A.* The eyelids, scrotum and prepuce, bones, hair, epidermis, brain, spinal marrow and serous system.

*Q.* Is there much serum in the healthy state of this texture?

*A.* There is not as much as is supposed. Recollect how it accumulates in disease.

*Q.* What is the nature of this serum?

*A.* It is proved to be albuminous.

*Q.* In which muscles, those of animal or those of organic life, is there most fat found?

*A.* There is little in the muscles of organic life; it abounds in those of animal life.

*Q.* Where is fat almost exclusively found in infants?

*A.* In the sub-cutaneous cellular texture.

*Q.* Where is it most abundant in adult life?

*A.* At that period the abdominal fat is in greatest abundance.

*Q.* In old age what becomes of the fat?

*A.* It disappears; perhaps it is not deposited, or the absorption may be more active.

*Q.* Is a considerable accumulation of fat to be viewed as a normal or abnormal process?

*A.* It is a morbid act, somewhat analogous to serous collections; it is the result of debilitating causes.

*Q.* To what causes may unnatural corpulency and emaciation be generally ascribed?

*A.* The pathological reason is a general or local disease or debility extended to the cellular texture. This disease or debility may originate there.

*Q.* What curious phenomenon is presented in the cellular texture of some birds?

*A.* The ortolan and other birds are said to fatten very suddenly in foggy weather.

*Q.* What is the colour of the fat?

*A.* It is white in early life, yellow in advanced life, and at the latter period it has a peculiar taste and smell.

*Q.* What causes tend to diminish the fat, or, in other words, to induce emaciation?

*A.* Protracted abstinence, prolonged organic affections, purulent collections depending on chronic malady, leucophlegmasia, the undue operation of depressing passions, increased evacuations, watchings, great degrees of heat, intemperance, and many other causes tend to emaciate the body.

*Q.* Has temperature of the body exclusive influence in preserving the fat fluid?

*A.* No; for both cold and warm-blooded animals have the fat fluid. It is a vital influence that keeps it liquid.

*Q.* What do you find frequently substituted for fat near the heart, in hydropic and phthisical patients?

*A.* A yellow transparent fluid, of a gelatinous aspect, having many of the characters of albumen.

*Q.* How is the fat formed?



*A.* By exhalation, through invisible vessels into the cellular texture.

*Q.* What is the adipose texture, as distinct from the cellular?

*A.* It is the texture in which fat is formed and contained.

*Q.* What is the structure of this adipose texture?

*A.* It is a soft, white structure, manifesting free extensibility and contractility of texture. It assumes the form of fine, semi-transparent laminæ. It is filled with little vesicles containing fat.

*Q.* What evidence is there that a peculiar organization is necessary for the formation of fat?

*A.* Because in many parts of the cellular texture there is no fat.

*Q.* What physiological fact is established by the absence of fat in many parts which have been mentioned above?

*A.* Its presence would destroy or impede their functions.

*Q.* Are the adipose vesicles impermeable?

*A.* They are; for though the fat be rendered fluid, if the adipose vesicle be unbroken, it does not escape. In this it differs from the permeability of the cellular texture.

*Q.* Is there any other material feature in which the adipose and cellular textures differ?

*A.* Yes; the uses of the adipose are partial, those of the cellular are general.

*Q.* What is the chemical nature of fat?

*A.* It is composed of stearine and elaine, of sebacic, margaric, and oleic acid.

*Q.* What are soaps?

*A.* Salts formed by the union of these acids with the base that is used.

*Organization of the Cellular System.*

*Q.* What is the organization of the cellular texture?

*A.* See the answer to the first question on this tissue; but it may be added here, that there is great diversity of sentiment on this topic. Of late, some distinguished anatomists have supposed it a homogeneous gelatinous substance, without evident organization.

*Q.* Where have you the best view of the organization of this cellular texture?

*A.* A part of the scrotum is the fittest part, as it has no fat in it.

*Q.* Are the laminæ of this texture delicate?

*A.* Yes; as much so as vesicles of soap and water blown from a pipe.

*Q.* What are the filaments composed of?

*A.* They are absorbents and exhalents.

*Q.* What are the evidences of the organic nature of this texture?

*A.* Its liability to disease.

*Q.* In what portions of this texture are fat and serum deposited?

*A.* In addition to what has been said, above of the adipose texture, it may be observed, that these fluids are deposited in little cells, which form reservoirs; these cells are composed of the transparent, non-filamentous layers. The cells containing fat are impermeable, those with serum freely communicate with each other.

*Q.* What remarkable tendency is manifested by the filaments and layers of the cellular texture?



*A.* They absorb the moisture of the atmosphere, as may be seen in dissecting rooms in moist weather.

*Q.* How is this texture classed?

*A.* Among the white organs yielding much gelatine.

*Q.* What are the effects of air, putrefaction, maceration, and ebullition, on this texture?

*A.* It is altered more slowly by exposure to these, than any of the white organs. It putrefies less readily; by long boiling it melts.

*Q.* Is it easily changed by the digestive processes?

*A.* It is not; compared with many other textures it is indigestible.

*Q.* What are the parts common to the organization of the cellular texture?

*A.* Blood-vessels, exhalents, absorbents, and nerves.

*Q.* Which vessels are most numerous?

*A.* The exhalents, and by their extensive function, they render this texture the seat of frequent and various disorders.

*Q.* What evidences the existence of absorbents in this texture?

*A.* The removal of fat and serum, the absorption of dropsical serum, and of ecchymosis; the removal of mild injected fluids; the disappearance of emphysema, and the drying up of ulcers.

*Q.* Are the absorbents numerous in proportion to the quantity of cellular texture in a part?

*A.* Yes; in the brain, where there is little of this texture, you find few absorbents, perhaps none.

*Properties of the Cellular Texture.*1. *Textural Properties.*

*Q.* What are the textural properties of this tissue?

*A.* Extensibility and contractility.

*Q.* How is cellular extensibility evidenced?

*A.* In fatty and serous cellular infiltrations, and in the extension of this texture in moving the limbs.

*Q.* Where is this extensibility most evident?

*A.* In the cellular tissue, under the skin, and between the muscles. It is slight in the sub-mucous texture.

*Q.* Is this property suddenly or slowly manifested?

*A.* In some instances with great rapidity, as you see in emphysema, and in cases of sudden tumefaction from fractures.

*Q.* What opposes the rupture of this texture?

*A.* Its extensibility, and a species of locomotion, by which, if too violently drawn, it displaces the contiguous cellular texture, draws it, and thus it is less extended.

*Q.* Under what circumstances does it lose this extensibility?

*A.* In several diseases, such as inflammation and cancer, &c.

*Q.* At what period is the contractility of texture greatest in this tissue?

*A.* In youth: it loses it in advanced life. The wrinkles of old age are owing to the cellular texture not contracting as in youth, so as to confine the skin close to the subjacent organs.



2. *Vital Properties.*

Q. Does this texture possess much animal sensibility?

A. Not in its healthy condition; but it is very evident in the pain which attends phlegmon.

Q. What proves the existence of organic sensibility?

A. The exhalation and absorption of fat, serum, and other liquids are the operations of organic sensibility.

Q. What instances show that all fluids have not the same relation to the organic sensibility of this texture?

A. Some foreign fluids, as blood, milk, and lymph, do not excite that property beyond the absorbing point; while others, as wine, urine, &c. carry it speedily to inflammation, and convert organic to animal sensibility.

Q. How do you prove the existence of insensible organic contractility in this texture?

A. The phenomena indicating organic sensibility, demonstrate the insensible organic contractility; these phenomena are absorption and exhalation.

Q. Does the cellular texture ever manifest *sensible* organic contractility?

A. You see it in the scrotum, which contracts on the application of cold.

Q. On what do the critical deposits frequently observed in acute diseases, depend?

A. On the sympathy of the cellular tissue with the diseased organ. "A man in the ward St. Charles, in consequence of great terror, had a sudden contraction of the epigastric region; a tinge of jaundice spread over his face in a few hours. In the evening he had a great

*œdema*, produced *sympathetically*, by the influence of the liver on the cellular texture."

Q. In what manner, and at what stages of their diseases, do the heart, lungs, stomach, and liver, affect this texture?

A. Chronic diseases of these organs in the last stages, induce debility of the cellular texture, with serous infiltrations; this is a sympathetic result.

Q. What inference relative to the cellular tissue is drawn from the state of the skin in chronic and acute diseases?

A. That the cellular texture may be similarly and sympathetically affected, and be like the skin, more or less dry or humid, at different periods of diseases.

Q. What vital forces are excited in passive cellular sympathies?

A. Organic sensibility and insensible organic contractility, for these predominate in this texture. Sympathetic action and disease always operate on the predominant vital forces of a tissue.

Q. You have said that this texture receives sympathetic impressions, under what circumstances does it radiate them?

A. When a phlegmonous inflammation excites fever, gastric and hepatic irritation, you have an example of active cellular sympathy.

Q. How may this active sympathy be profitably employed?

A. In the use of issues; for the cellular active sympathy from the issue, is more powerful than those of the skin from a blister.



Q. Why does inflammation progress more rapidly in the cellular texture than in the aponeurosis, tendons, and cartilages?

A. Because the cellular vital forces are much more active than those of the textures just named.

Q. Does cellular pus differ from cutaneous, mucous, and osseous pus?

A. It does. Cellular pus is the ordinarily received standard for pure pus; but erroneously, because the different textures throw out different kinds of pus, all of which are as healthy as the cellular.

Q. Has the cellular texture of each organ peculiar vital forces?

A. Certainly not. These forces differ only in degree; being greater in the cellular tissue of the skin, less in that of the cartilages.

Q. Why does an artery escape suppuration, though soaked in pus?

A. Because arterial and venous cellular texture being altogether filamentous, its vital forces are not excitable to the point of inflammation, as that texture is which is composed both of filaments and layers.

### 3. *Properties of Reproduction.*

Q. What remarkable feature distinguishes the cellular texture from others?

A. A property of reproduction, an elongation, a species of vegetation!!

Q. What depends on this property?

A. The formation of cicatrices, tumours, cysts, &c.

Q. In considering cicatrices, how do you divide them?

*A.* Into those of the external, and those of the internal organs.

*Q.* What steps does a wound take from its formation to its cicatrization?

*A.* Inflammation, granulation, suppuration, depression of surface, formation of pellicle at first red, then white.

*Q.* What purposes does inflammation secure to a wound?

*A.* By it the organic sensibility of the cellular texture is raised to animal sensibility; and the insensible organic contractility is so exalted, that these together excite the reproductive powers of the texture, in the form of granulations.

*Q.* What are granulations?

*A.* Not fleshy tubercles, but small cellular vesicles filled with a thick lardaceous substance.

*Q.* What is the provisional pellicle covering granulations?

*A.* That which prevents the contact of air while the permanent cicatrix is forming.

*Q.* What are the evidences of the cellular nature of granulations, and of the pellicle that covers them?

*A.* As granulations are the same in every texture, and as the cellular tissue is the only one common to all the organs, it is inferred that they are cellular; again, where the cellular texture is most abundant, granulations form most readily; when the cellular texture is removed, the difficulty of reproduction is great; maceration of the granulating surface of a wound exposes this textural base.

*Q.* Then granulations are not elongated vessels?

*A.* No; they are cellular elongations; for the cellular texture alone is capable of self-extension, increase and reproduction.



*Q.* If granulations are uniformly cellular throughout the textures, how is it that the various organs are renewed?

*A.* In the cells of these granulations, depositions are made of the nutritive matter, peculiar to the various organs. For instance, when the bone is broken, gelatine and phosphate of lime are thrown into the granulations; if a muscle is to be renewed, fibrine is deposited.

*Q.* Explain the difference in this third period of cicatrization in the internal and external lesions?

*A.* The third period is that of deposition of nutritive matter spoken of in the last question. Now, in the internal organs, nutritive matter is deposited; but in external lesion, pus is exhaled and thrown off, as possessing nothing nutritive or reuniting.

*Q.* In external cicatrices, what comes of the fatty matter contained in the cells?

*A.* They are emptied of it in the process of suppuration.

*Q.* What follows this emptying of the cells?

*A.* They sink and adhere to each other, contract, and thus form a uniform substance covered with a membrane.

*Q.* When is this membrane of the cicatrix complete?

*A.* When the adhesion between all the cells which first form the fleshy granulations is complete; the membrane is the result of this adhesion.

*Q.* Why is this membrane at first red, then white?

*A.* Because at first red blood circulates in the exhalents; after a time it leaves them, and returns to its own vessels.

*Q.* What parts are most favourable to the formation of cicatrices?

*A.* Those where the skin yields most, as the scrotum.

Where the skin yields least, as on the head, tibia, and sternum, cicatrices are largest.

*Q.* How does union by the first intention differ from cicatrization?

*A.* In the union, the periods and processes of cicatrization do not appear: the union is by an agglutination of the sides of the wound.

*Q.* By what property do cicatrices contract?

*A.* By organic contractility in the cellular vesicles.

*Q.* What is fungous flesh?

*A.* Exuberant formations of cellular vesicles in wounds and ulcers.

*Q.* Whence and what are polypi?

*A.* These and all other excrescences arise from a morbid reproductive effort, or spontaneous elongation of the cellular texture.

*Q.* How do you account for the differences in tumours?

*A.* They arise from the variety of deposits made in the elongated cellular texture.

*Q.* Is there no way to account for this variety in the deposits?

*A.* It depends on the degree of the vital forces in the elongated textures; a higher exercise of these forces producing one deposit, a lower another.

*Q.* But are there not tumours independent of this elongating action of the cellular texture?

*A.* Yes; those of a chronic character, from infiltration of the cellular texture.

*Q.* What is a cyst?

*A.* A membranous sac without opening, developed accidentally; cysts contain fluids of different sorts.

*Q.* What texture forms them?



*A.* The cellular. They resemble the serous membranes, and they are cellular.

*Q.* What analogies prove the identity of cysts and serous membranes?

*A.* Their conformation: their structure, for maceration and inflation prove cysts to be cellular; they have few blood-vessels and many exhalents. The vital properties prove the identity; they are, in a natural state, destitute of animal sensibility, but, like serous membranes, when inflamed they have it exquisitely; cysts have much organic sensibility. The functions of cysts confirm the identity, these are absorption and exhalation. Diseases prove the similarity, their pathological states resemble those of serous membranes.

*Q.* Can you demonstrate that absorption takes place in cysts?

*A.* If it does not, how are the fluids in encysted dropsy removed?

*Q.* How are cysts formed?

*A.* Not, as is commonly supposed, by the gradual deposition of a fluid in a cell of the cellular texture, but by a departure from the common process of increase in the tissue which they resemble; and in which these cysts are formed.

*Q.* What relation then is there between the growth of a cyst, and the increase of the fluid contained?

*A.* The membranous sac is first deposited; the exhalents begin to throw out fluid, and as these vessels increase in the membrane the fluid is increased, and consequently the encysted tumour enlarges.

## DEVELOPMENT OF THE CELLULAR TEXTURE.

*Q.* What is its aspect in the earliest foetal period?

*A.* It predominates almost exclusively in the primordial mucous mass. It is at first mucous, then gluey, then cellular texture appears. It becomes less fluid as the foetus grows.

*Q.* What is the nature of the fluid so abundant in the cellular texture, early after conception?

*A.* It is albuminous and gelatinous.

*Q.* Is the foetus ever emphysematous?

*A.* The delicacy of the cellular layers prevents this state; they burst rather than bear the pressure of air in the cells.

*Q.* What is the condition of the vital energy of this texture in youth and infancy?

*A.* Very active; hence wounds speedily cicatrize, serous infiltrations are rapidly removed, dropsies seldom occur in infancy, tumours form and increase rapidly. The vital forces are energetic.

*Q.* What is the cause of the roundness of form which characterizes the infant?

*A.* The quantity of cellular texture concealing the organs.

*Q.* What change does after and advanced age produce on this texture?

*A.* It becomes firmer, more condensed, and diminishes in proportion.

*Q.* In what temperament does it preponderate?

*A.* In the phlegmatic or lymphatic.

*Q.* Is it more abundant in males or females?



*A.* In females, hence the roundness of their forms.

*Q.* Whence the laxity of the cellular texture in old age?

*A.* It arises from the loss of its vital forces, particularly organic contractility.

*Q.* Whence the emaciation of age?

*A.* The cellular texture dries, decays, withers away.

*Q.* Where are osseous incrustations in this texture most frequently found?

*A.* In the texture between the uterus and rectum.

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#### PATHOLOGY OF THE CELLULAR TISSUE.

*Q.* What are the principal diseases of this texture?

*A.* Phlegmon, carbuncle, furuncle, scleremia, ulcers, anasarca, œdema, hæmorrhage, morbid fatness, emaciation, emphysema, wens, cysts, steatoma, atheroma, meliceris, and sometimes hydatids.

*Q.* To what part of the cellular tissue do you allude when you speak of its diseased state?

*A.* Principally to that found in the interstices of parts.

*Q.* What texture of the body is exclusively subject to swelling?

*A.* The cellular; the swelling of all tissues is owing to the cellular which enters into their composition.

*Q.* How are diseases extended from one organ to another?

*A.* By means of the cellular, continuous texture.

*Q.* What divisions will you make of the diseases of the cellular texture?

*A.* Into idiopathic, symptomatic, and diseases from

continuity of tissue. Phlegmonous inflammation indicates the idiopathic; the spread of carcinoma, the continuous; and serous effusion from organic disease, the symptomatic.

*Q.* What are the symptoms of phlegmon?

*A.* Swelling, redness, pain, induration, heat, pulsation; sometimes general and gastric symptoms.

*Q.* How does phlegmon terminate?

*A.* In resolution, most frequently in suppuration, in chronic inflammation of the cellular texture, with or without serous effusion, and in gangrene.

*Q.* Is pus at once immediately deposited in the cavity of an abscess?

*A.* It is first formed in little cells, which, gradually communicating, form the cavity of an abscess.

*Q.* What do you mean by carbuncle?

*A.* A tumour having its seat in the sub-cutaneous cellular texture.

*Q.* What are the distinguishing symptoms of carbuncle?

*A.* A livid colour, greater hardness than phlegmon, phlyctenæ appear on its surface, the skin is gangrenous, the discharge is ichorous, the pain is peculiarly hot, the general strength of the patient is much reduced.

*Q.* Does carbuncle depend alone on the intensity of the inflammation?

*A.* It does not; there is a poisonous cause, or specific one, concerned in the production of anthrax.

*Q.* There is a recent speculation as to the cause of the eschar in carbuncle, what is it?

*A.* It is that the portion of cellular texture composing the eschar, is in an incarcerated, or strangulated condition.



Q. What do you mean by furuncle?

A. It is an inflammation in the cellular tissue and *dermoid texture*, less violent, of slower progress than phlegmon, occurring sometimes several at a time, and does not, like phlegmon, leave a cicatrix.

Q. What parts are exempt from furuncle?

A. The palms of the hands, the soles of the feet, and the cranium.

Q. What do you understand by scleremia?

A. An induration of the sub-cutaneous cellular texture of infants, when an incision throws out yellow fatty serum.

Q. To what has this disease been ascribed?

A. To syphilitic taint, to deranged perspiratory function, and to an affection of the respiratory process, to an opening of the foramen ovale.

Q. What do you mean by an ulcer?

A. It is a suppuration of a wound or injury, which is prolonged after the ordinary stages of inflammation have been completed.

Q. What are ulcers owing to?

A. To a chronic inflammation of the cellular texture.

Q. What materially influences the condition of ulcers?

A. The peculiar vital forces of different parts.

Q. How is cellular dropsy divided?

A. Into general and partial.

Q. Where do you find dropsy most frequently?

A. In the most dependant parts of the cellular texture.

Q. What are other divisions of dropsy?

A. It is idiopathic and sympathetic. It is symptomatic of fever and of organic disease.

*Q.* Is the cellular tissue altered in dropsy?

*A.* It is not; the cells are only distended with the increased exhalation of serum.

*Q.* To what are the sudden swellings in fractured limbs and contusions owing?

*A.* Neither to an œdematous nor emphysematous state of the cellular texture, but to "a peculiar excitation of it."

*Q.* How do you account for swelling of the belly in enteritis?

*A.* It is owing to a swelling of the sub-cutaneous cellular tissue.

*Q.* What portion of the cellular texture is most liable to inflammation?

*A.* The sub-cutaneous.

*Q.* What state of the cellular texture does obesity indicate?

*A.* A debility in the tissue, and an undue disposition to deposite fat.

*Q.* Whence does leanness, emaciation, arise?

*A.* From organic diseases, but not of those of the brain or heart. It proceeds commonly from organic disease of the abdominal viscera, and of the lungs. Emaciation is usually symptomatic. You know that the depressing passions induce emaciation.

*Q.* At what part does emphysema commence?

*A.* Always near the thorax, near the lungs. Fractures of the ribs, wounds of the chest, and vehement vocal exertions cause it.

*Q.* What tumours form in the cellular tissue?

*A.* Wens and cysts.



Q. What is the base of the fluids of wens?

A. It is albuminous.

Q. Are the sub-mucous, sub-serous, or vascular cellular tissues often diseased?

A. You never see disease of the sub-mucous cellular tissue, unless when an abscess forms near the rectum. In the sub-serous, matter forms more commonly, and it points externally; while, to prevent the pus finding its way into the serous cavities, that tissue is thickened. The sub-vascular cellular tissue is never diseased.

## NERVOUS SYSTEM.

*Q.* How should the general nervous system be divided?

*A.* Into that belonging to animal life, and that attached to organic life.

### I. NERVOUS SYSTEM OF ANIMAL LIFE.

*Q.* What is the centre of the nervous system of animal life, and what are the parts to which it is distributed?

*A.* The brain and its dependencies form the centre, and the nervous system of animal life is distributed to the senses and the organs of voluntary motion.

*Q.* What is the centre of the nervous system of organic life, and where are the nerves distributed?

*A.* The ganglions are the central points, and the nerves are distributed to the organs of digestion, circulation, respiration, and secretion.

*Q.* Is the distinction in nervous distribution preserved with unvarying precision?

*A.* There are a few comparatively unimportant deviations.

*Q.* Name a leading peculiarity in this nervous system of animal life.

*A.* Its symmetrical character; the nerves go off in pairs.

*Q.* What renders this duplicate organization evident?

*A.* Dissection and disease exhibit the right and left nervous system of animal life. In palsy one side will be affected, while the integrity of the other side is unimpaired.



*Q.* What relation does the size of the brain bear to the nerves, in man and quadrupeds?

*A.* It is in an inverse proportion. In man, the brain is very large in proportion to his nerves; in quadrupeds, generally, the brain is small and the nerves large.

*Q.* What is the result of this?

*A.* That although brutes are superior in some of the senses to man, man in the sense of touch surpasses animals greatly. Touch implies intellect beyond instinct; hence the perfection of the organs of touch and the development of the brain, are, in man, in proportion to each other.

*External forms of the Nervous System of Animal Life.*

*Q.* From what part of the brain do the cerebral nerves originate?

*A.* From the cerebrum, tuber annulare and its continuations, and from the medulla spinalis.

*Q.* To what opinion did this origin of these cerebral nerves give rise?

*A.* As none originated from the cerebellum, the cerebrum was said to be the source of the voluntary, and the cerebellum that of the involuntary motions.

*Q.* To what nerves does the cerebrum give rise?

*A.* To the olfactory and the optic.

*Q.* For what are these nerves remarkable?

*A.* Their adhesion is firm at their origin from the brain, and they are much softer than most of the other nerves.

*Q.* What nerves arise from the tuber annulare and its elongations?

*A.* The motores communes of the muscles of the eye, the pathetici, the trigemini, the motores externi of the eye,

the facial, the auditory, the par vagum, the glosso-pharyngeal, and the great hypoglossal.

*Q.* Is the adhesion of these nerves to the brain strong?

*A.* No; they are so weak as to be torn by the raising of the pia mater.

*Q.* What nerves arise from the spinal marrow?

*A.* The cervical, eight pairs in number; the dorsal, twelve pairs; five sets of lumbar; five or six sacral; in all amounting to thirty or thirty-one pairs. The spinal nerve, so called, which penetrates the cranium and again emerges from it, also arises from the spinal marrow.

*Q.* Are the nerves elongations of the brain?

*A.* They are not; they are formed cotemporaneously with the brain, and are independent organs communicating with the brain.

*Q.* What has given rise to the opinion of the decussation of all the nerves?

*A.* The supposition is founded on the fact, that paralysis occurs on the side of the body opposite to the hemisphere of the brain that is injured.

*Q.* Does anatomy prove this decussation?

*A.* It does not.

*Q.* Does palsy in the motion of a limb necessarily involve loss of sensation in the member?

*A.* It rarely suspends sensibility.

*Q.* On what do discordant hearing and vision often depend?

*A.* Frequently on a diseased condition of the organ affected, which does not involve a morbid state of the brain.

*Q.* What membranes are found about the nerves?

*A.* The dura mater invests them to their exit from the brain and spine. The tunica arachnoides envelopes the



nerves from their connexion or junction with the brain, to their exit from the bony canal. The pia mater continues on the nerves.

*Q.* How do the tunics of the optic nerve differ from those of other nerves?

*A.* It has a fibrous investment from its origin to the sclerotic coat.

*Q.* What nerves converge after their origin?

*A.* The olfactory; all the rest remain separate.

*Q.* What nerves go to their destination without communicating with other nerves?

*A.* The olfactory, the optic and auditory.

*Q.* Do the nerves of the spine make their egress immediately opposite their origin?

*A.* They do not; the lower or lumbar run several inches in the spinal canal before they leave it.

*Q.* Of what practical import is this fact?

*A.* In order that moxa should be applied at the origin of the nerves, the immediate exit of the cervical from the spine, and the long course within the spinal column which the lumbar pursue before their exit, should be well known.

*Q.* How are the plexuses of the spinal nerves formed?

*A.* By each nerve sending a branch to the one above and below it.

*Q.* How do you best understand the distribution of the spinal nerves?

*A.* By taking them as they arise from the plexuses and not regarding them as pairs of nerves.

*Q.* Are the plexuses confined to those at the exit of the nerve?

*A.* No—other communicating chords form as the nerves proceed in their course.

*Q.* Of what are the nervous trunks composed?

*A.* Chords and filaments.

*Q.* Do the chords of a nervous trunk communicate?

*A.* They do by filaments. The chords which end the trunk are not composed of the same filaments which commenced them.

*Q.* Why do you object to the opinion of their being distinct nervous chords which serve for sensation and motion?

*A.* The inter-communication of the filaments forbids the supposition.

*Q.* What do you mean by the termination of the nerve?

*A.* The point where each filament ends.

*Q.* How many modes of termination have filaments?

*A.* They have three; with other filaments of the same system; with filaments of the system of ganglions, forming anastomoses; and filaments lose themselves in the organs.

*Q.* How are the filamentary nervous communications to be distinguished?

*A.* There are those of real anastomosis, and those of juxta-position and contiguity.

*Q.* Why are sympathies not exclusively ascribed to nervous anastomoses?

*A.* Because these anastomoses are rare, compared with the numerous and diversified sympathies, normal and abnormal.

*Q.* How many kinds of anastomosis are there?

*A.* There are three; viz. that formed by two branches of different nerves; the anastomosis formed by the branches of the same nerve; and the one which arises from the union of two nerves of the same pair, or of different pairs at the median line.



Q. Where is this median anastomosis seen?

A. In the superficial nerves of the neck and chin.

Q. What feature in paralysis does this median anastomosis explain?

A. Probably some mobility in a part which is affected with paralysis.

Q. What systems are destitute of nerves?

A. The cartilaginous, the fibro-cartilaginous, the pilous, the epidermoid, and others, are unprovided with nerves.

Q. What peculiarity is found in the terminations of the optic, olfactory, and auditory nerves?

A. The pulp of these nerves is expanded on the organs without the covering of the nerve.

### *Organization of the Nervous System of Animal Life.*

Q. What is the organization of the nerves of animal life?

A. Filaments in apposition form chords, and chords in apposition form trunks of nerves.

Q. Is the internal organization of the nerves uniform?

A. It is not—it is singularly diversified.

Q. What is the organization of each nervous filament?

A. An external membrane forming a canal; containing the medullary matter or pulp.

Q. What is the nature and origin of the nervous coat?

A. It is the pia mater of the brain and spinal marrow.

Q. What are the three great modifications of the pia mater?

A. On the gray substance surrounding the brain and cerebellum it is red, highly vascular, loose, and easily se-

parated and raised up; on the white substance which invests the tuber annulare and its four elongations received from the brain and cerebellum, it is not so red, it becomes firmer, more adherent, not so easily torn; on the spinal marrow and nerves it increases in density, becoming whitish and resisting.

*Q.* What purpose does this density of the spinal pia mater subserve?

*A.* It serves as a protection and support to the spinal marrow, especially where the marrow, not filling the vertebral canal, would, without this firm coat, be liable to concussion.

*Q.* What effects have acids on this nervous coat?

*A.* They harden it immediately, but it soon regains its softness. Water hardens the nerves exposed to its action.

*Q.* Whence does the medullary matter of the nerves originate?

*A.* It is continuous with the medulla of the brain and spinal marrow.

*Q.* In what nerves is it most abundant?

*A.* In the auditory and optic nerves. In the progress of a nerve to its termination it diminishes.

*Q.* What general influence has loss of natural moisture on the whiteness of parts?

*A.* It destroys their whiteness.

*Q.* In what respects do the cerebral and nervous medullary substances differ and agree?

*A.* The cerebral medulla putrefies soon, the nervous slowly. Acids harden both; alkalies soften them. The cerebral substance is digestible; the nerve is not.

*Q.* Is the medulla the same in all the nerves?



*A.* It appears to differ, in different nerves, in consistence, in the degree of moisture, in its colour, and other particulars.

*Q.* On what does the different sensibility of the various parts depend?

*A.* On the diversity of organization in the parts, on the different organization of the nerves, and on the varying consistence and appearances of the medullary matter.

*Q.* Is the nervous medulla a fluid?

*A.* It resembles jelly. It is more like a fluid than a solid.

*Q.* Have the nerves cellular texture?

*A.* In the interior of the brain and spine there is none. When the nerves emerge from the cranium and spine, they have much cellular tissue around the trunks, chords, and filaments. Perhaps the nervous coat is the cellular texture condensed.

*Q.* How do the arteries supply the nerves?

*A.* Blood-vessels pass between the chords to supply the filaments.

*Q.* What influence has arterial blood on the nerves?

*A.* It is to the nerve what blood is to every organ; the stimulus which supports and perpetuates functional power.

*Q.* What influence has an increased determination of blood to the nerves?

*A.* It increases nervous action, and when the determination is very great it overwhelms it.

*Q.* How is the nervous medulla formed?

*A.* The arteries of the nerves deposite in the exhalents this nervous matter, which is then thrown out.

*Q.* Then the nervous coat does not secrete it?

*A.* The nervous coat has no more agency in secreting

the nervous medulla, than the pia mater has in secreting the substance of the brain.

*Q.* Does the brain supply the nervous medulla?

*A.* On the contrary, it has been just said that the medulla is deposited by the arteries of the nerve.

*Q.* What pathological facts does this arterial nutrition of the nerves explain?

*A.* It accounts for the preservation of the inferior portion of a cut nerve; for the continued nutrition of a nerve from which cerebral communication has been cut off by ligature; and for the uninterrupted support of a nerve, which, in palsy, may have ceased to correspond with the brain. The secretion of nervous medulla, and the nutrition of nervous organization by the arteries, explain these facts.

### *Properties of the Nervous System of Animal Life.*

*Q.* Do the nerves manifest much textural property?

*A.* They do not. If extension be suddenly made, it is dangerous, but if gradually applied, it is borne to a considerable degree. The nerves possess little contractility of texture.

*Q.* How is nervous sensibility divided?

*A.* Into inherent and common.

*Q.* In what part of a nerve does animal sensibility reside?

*A.* In the medullary substance; the nervous coat has very little. This medullary substance has animal sensibility to a very great degree.

*Q.* Why are nerves not painful when surrounded by fluids, tumours, or when exposed to the air?



*A.* Because there is so little animal sensibility in the nervous coat.

*Q.* What effect has repeated irritation on the animal sensibility of nerves?

*A.* It is gradually diminished, and by rest is reaccumulated.

*Q.* What are the peculiarities of nervous animal sensibility?

*A.* Observe the peculiarity of pain in the different organs; how the sensation of pain in the dermoid texture, for instance, differs from that in the muscular or osseous texture. Another feature interesting to the physician and surgeon is, that the trunk of a nerve partially irritated, the animal sensibility will often be exalted in all the branches; as when pain is felt along the forearm when the cubital nerve is compressed or struck at the elbow; this is further illustrated in *tic dolooureux*, and in irritation of points of the sciatic nerve. In these the irritated point is a centre from which painful irradiations are diffused.

*Q.* Does the increase of animal sensibility ever take place between the injured point and the brain?

*A.* It does not; it is an affection continued along the branches.

*Q.* What example is given to illustrate the different animal sensibility or pain in different textures?

*A.* The case of a man is related by Bichat, who in the course of an amputation, asked the surgeon why it was that the pain in cutting through the skin was so different from that felt in the division of the muscles.

*Q.* How many kinds of sensation arise from the internal sensitive principle?

*A.* Two—the external and internal.

*Q.* How are the external sensations divided?

*A.* Animal sensibility with regard to external sensations is *general* and *particular*. The *general* refers to impressions made by bodies on the external surface. The *particular* relates to the sensibilities of particular organs to peculiar impressions, as the eye to light.

*Q.* But have not some organs of animal life both general and peculiar animal sensibility?

*A.* They have. For instance, the tongue may feel the impression of a substance, without the sense of taste being excited. The nerves of general and peculiar sensibility are absolutely distinct.

*Q.* How does opium relieve pain?

*A.* By suspending the action of the brain, so that neither external nor internal sensations are perceived.

*Q.* Do the nerves possess animal contractility?

*A.* Not at all; that property appertains to the muscles.

*Q.* What agency then have the nerves in the muscular animal contractility?

*A.* They transmit the principle of motion. In animal contractility there are three agents; viz. the brain that wills, the nerve conveying cerebral volition, the muscle which obeys in action.

*Q.* Do the nerves exercise much organic contractility and sensibility?

*A.* They do not. They exercise these properties of life so far as nutrition requires them. The nerves abound with animal sensibility.

*Q.* Is there a difference in the size of the nerves of a sound and paralytic side?

*A.* They are alike. The nerves are not affected in many diseases. Their nutrition goes on, and organic



sensibility is so little increased as not to enlarge the nervous trunks.

*Q.* In what abnormal condition did Bichat once find the sciatic nerve?

*A.* With the veins of the nerve in a varicose state.

*Q.* Do the cerebral nerves affect the organic sensibility of textures?

*A.* They do not; that property of the textures is beyond the sphere of those nerves.

*Q.* Recapitulate the functions over which organic sensibility presides?

*A.* It supports capillary circulation; secretion; exhalation; absorption; nutrition.

*Q.* What excites these functions?

*A.* The fluids excite the organic sensibility of the solids, which last in action exercise insensible organic contractility.

*Q.* What general considerations induce the belief that the nerves of animal life do not preside over and influence these functions?

*A.* They are said to receive no impulse from the nerves of animal life, because no filaments from these nerves go to the capillaries; some of these organic functions are most active during sleep, at which time the animal nervous system is quiescent; and cartilages which receive no nerves have nutrition as well as other parts.

*Q.* Over what diseases do organic sensibility, and insensible organic contractility preside?

*A.* Over tumours, dropsies, morbid sweating, hæmorrhagies, disorders of secretion, and such like affections.

*Q.* What diseases arise from disordered animal sensibility and contractility?

*A.* Spasm, convulsion, palsy, somnolency, torpor, derangement of the intellectual functions; in a word, every thing which tends, in disease, to interrupt our relations with surrounding bodies; these belong to alterations of animal sensibility and contractility.

*Q.* Does proneness to inflammation depend on the number of nerves in a part?

*A.* Those parts which have the greatest number of nerves are not most liable to inflammation.

*Q.* What do you understand by sympathy?

*A.* It is an impression in health or disease, not arising from a natural connexion of functional operation; the impression is conveyed from an organ to the nervous system, or a portion thereof.

*Q.* How do the nerves sympathize in disease?

*A.* There is a sympathy between two nerves of the same pair; as when one optic nerve induces the other to sympathy. Again, two nerves of the same side, but not of the same trunk, sympathize, as when blindness results from the injury of the frontal nerve. Again, two branches of one trunk sympathize with each other; and nerves sympathize actively and passively with other organs.

*Q.* What is the rationale of nervous sympathy on remote parts?

*A.* Nervous sympathy operates on the predominant vital properties of the parts engaged; increasing *animal sensibility* in pain of the head; or *animal contractility* in sympathetic convulsions; or *sensible organic contractility* in the action of the heart, or in contractions of the stomach in vomiting. These, in different cases and persons, are excited by irritation of a nerve.

*Q.* What have been considered the media of sympathy?



*A.* Nervous anastomoses, vascular communications, or the continuity of cellular and mucous tissue.

*Q.* What is the most rational division of sympathies?

*A.* Into those which actuate animal and organic sensibility and contractility.

*Q.* Can you explain the sympathies of animal sensibility?

*A.* They depend on an irregularity or derangement of perception in the brain, by which, an impression made on one part, is referred to another; nervous communication is not necessary to this.

*Q.* On what does the sympathy of animal contractility depend?

*A.* The impression is made on the muscles through the brain.

*Q.* Are nerves, when cut, reproduced?

*A.* They are, as other parts are.

*Q.* How are external sensations transmitted?

*A.* Uniformly by the nerves. The internal sensations are conveyed in an unknown manner.

### *Development of the Nervous System of Animal Life.*

*Q.* What is the state of the brain and nerves in the foetus?

*A.* Inactive, but much developed. The nerves in infancy are much larger in proportion to the body, than those at adult life; so likewise is the brain.

*Q.* What remarkable change takes place in the animal nervous system at birth?

*A.* In foetal life it is supplied with black blood, at the commencement of independent life it has red blood.

*Q.* This red blood performs two functions on the brain—what are they?

*A.* It contributes nutrition to the brain, and excitation as a stimulant.

*Q.* What is necessary to the commencement of animal life?

*A.* That the organs be influenced by red blood.

*Q.* What cooperates with this red blood to excite animal life at birth?

*A.* External impressions, and those made on the mucous surfaces.

*Q.* What is the conspicuous feature in asphyxia?

*A.* The apparent absence of animal life.

*Q.* How does asphyxia differ from foetal life?

*A.* In the foetus, organic life goes on. The blood differs in the foetus from the black blood of asphyxia—one, the foetal, is a natural state of the blood, the other is a morbid state.

*Q.* What functions predominate in infancy?

*A.* The animal; hence a constant susceptibility to external impressions; the constant action of the voluntary muscles, in the desire to touch and grasp what is seen; hence the predominance of the diseases of the animal functions, the frequency of cerebral disease and convulsions.

*Q.* Why do infants sleep so frequently and so much?

*A.* The activity of the animal functions fatigues the brain, demands repose, and produces sleep.

*Q.* Are the same systems predominant at different periods of life?

*A.* They are not. The brain and nerves predominate in infancy; the uterus in the girl; the lungs in robust manhood; the gastric viscera in advanced life.



*Q.* Why does so great a portion of blood go to the brain in infancy?

*A.* The predominance of the vital forces of the brain invites it.

*Q.* What is the comparative consistence of the brain in foetal and senile life?

*A.* Nearly fluid in the foetus, it becomes quite firm in old age, being progressive in its change from the fluid to the firm state. The vascularity of the animal organs diminishes with age; their colour becomes dull. These changes take place in the brain as well as nerves.

*Q.* Give a brief account of the formation of the cerebral mass.

*A.* The hemispheres of the brain assume on their first development the membranous form. The gray or cortical substance is formed subsequently to the white. The medullary substance of the brain, and the white substance of the medulla spinalis, are filamentous and fibrous. The structure of the cortical substance is not yet ascertained, perhaps it is fibrous.

*Q.* What is the chemical composition of the cerebral mass?

*A.* It is composed of a white, shining fatty matter; of a smaller portion of a red fatty substance; of water, albumen, osmazone, sulphur, phosphate of potash, lime, magnesia, with some appearances of muriate of soda.

*Q.* State briefly Beclard's view of some points in the nervous structure.

*A.* He states that the nervous filaments do, at their origin, penetrate into the substance of the brain. The nerves probably arise from the gray substance, not from the medullary. The nervous filaments of the medulla oblongata do decussate. The nervous texture is composed of globules.

Q. What are the principal pathological states of the brain?

A. The brain is diminished in concussion, so as not to fill the cranium. The brain is subject to a softening, as well as to an induration of its substance. The brain suppurates, forms tumours, tubercles, osseous depositions. BICHAT *had the lobes of the brain of very unequal size.* The nerves are enlarged in some cases, and atrophic in others. The nerves cicatrize, but are never preternaturally produced.

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## II. NERVOUS SYSTEM OF ORGANIC LIFE.

### *General Remarks.*

Q. How should the ganglions be considered?

A. Each as a distinct centre distributing or receiving nerves.

Q. How does the system of organic nerves differ from the nerves of animal life?

A. In the system of animal life the brain is a single centre; in that of organic life there are as many centres as ganglions. In animal life the nerves are symmetrical, in the organic system they are irregular. The nerves of organic life do not serve for sensation, as those of animal life do. The nerves of organic life have no connexion with voluntary locomotion, the animal nerves control this. The organic system of nerves belongs to internal life, the animal nerves to the external or life of relation. Lastly, ganglions are not found in the head.



*Q.* Is the sympathetic properly termed a nerve?

*A.* It is not one nerve; it is a series of nerves derived from the ganglions or little brains.

### *Of the Ganglions.*

*Q.* What are the ganglions?

*A.* The ganglions are small bodies of a red or gray colour, deeply situated along the vertebral column and well protected; and from them are sent numerous nervous ramifications. They are not moveable.

*Q.* What do these ganglions or ramifications form?

*A.* That which is termed the great sympathetic nerve.

*Q.* What ganglions are uniformly found?

*A.* The superior cervical, the semilunar, the ophthalmic; others are sometimes wanting.

*Q.* What is the form of these bodies?

*A.* They are irregularly formed; sometimes round, or flat.

*Q.* Is the organization of the ganglion and cerebral substance similar?

*A.* They are not alike in this respect. The ganglions are susceptible of the horny hardening as solids are; the cerebral substance does not admit that change. The ganglions are not fibrous, the cerebral substance is.

*Q.* What is Scarpa's opinion of the organization of the ganglions?

*A.* That they are a kind of expansion of the filaments of the nerves. Bichat thinks not, but says they are homogeneous and sui generis.

*Q.* How do the ganglions differ from the ganglionic nerves?

*A.* In their colour, consistence and properties.

*Q.* What kind of membrane envelopes the ganglions?

*A.* The cellular membrane, resembling the sub-mucous and arterial cellular coat.

*Q.* What are the vital properties of the ganglions?

*A.* Organic sensibility and insensible organic contractility.

*Q.* What proves that they are destitute of animal sensibility?

*A.* Bichat opened a dog; he irritated the semilunar ganglion, without giving the animal pain: he irritated a cerebral nerve, it excited great pain.

*Q.* What important division is to be made in the general class of nervous disorders?

*A.* They are divisible into those which arise from the nerves of animal, and those from the nerves of organic life.

*Q.* Name several of the diseases of the nerves of animal life?

*A.* Convulsions, palsy, hemiplegia, tetanus, catalepsy, apoplexy, and the greater number of epilepsies, disorders of sight, hearing, taste, smell.

*Q.* Now present some of the diseases of the nerves of organic life.

*A.* Hysteria, hypochondriasis, melancholy, diseases of the abdomen and chest. Reflect on the difference in the two classes of diseases alluded to in this and the preceding question.

*Q.* Does the pain felt in the viscera of organic life differ from that in the viscera of animal life?

*A.* It does. The intestinal pains, those felt in the loins from uterine affection, the burning at the stomach, all dif-



fer much from the pain of the organs of animal life. There is like difference in convulsive actions of animal and organic life.

Q. Is the ganglionic system developed as early as the brain?

A. By no means. The ganglions, when first developed, are not as soft as the foetal brain.

Q. What pathological inference is deducible from the earlier development of the cerebral organ?

A. That diseases of the animal nervous system prevail in infancy, from the early development of that system.

Q. Does the connexion of the nerve with the ganglion resemble that of the nerves with the brain?

A. The nerves are more firmly united to the ganglions than the cerebral nerves are to the brain. The nerves of organic life differ much more from the ganglion than the cerebral nerve does from the brain.

Q. What do you mean by cerebral ganglions?

A. An enlargement of the spinal nerves at their exit from the spine; their organization resembles the organic ganglions, but they differ in sensibility. For example, if the superior or inferior cervical ganglion be irritated, the muscles supplied by them remain unaffected: irritate a cerebral ganglion, and behold the convulsions which will be excited.

### *Of the Nerves of Organic Life.*

Q. What is the course of the organic nerves?

A. They communicate with the nerves of animal life; then each ganglion sends nerves to the next ganglion, with one exception; some nerves go to the cerebral muscles, the

diaphragm, and some muscles of the neck; they intercommunicate chiefly so as to form plexuses, into which the animal nerves send a few branches.

*Q.* In any plexus do the animal nerves predominate?

*A.* In the pulmonary the par vagum does.

*Q.* How do you account for the innumerable interlacings of the organic nerves?

*A.* The filaments are not generally united in a trunk, as the animal nerves are; the first run separately, not bound in bundles.

*Q.* What is remarkable in the course of the organic nerves?

*A.* They surround the arteries for some distance, like a net-work. It is not so with the cerebral nerves, which are in apposition only with the vessels.

*Q.* What effects proceed from this reticular nervous envelope around the vessels?

*A.* The motion of the blood may have some effect on the nerves. In support of this opinion it may be remarked, that as nature has placed a great number of arteries at the base of the brain, to agitate it with an alternate motion, she has also put the most considerable plexus of the whole organic system upon one of the places to which the red blood communicates the strongest impulse, viz. upon the trunk of the cœliac artery.

*Q.* What is the structure of the organic nerves?

*A.* Some are in chords, like the animal; others are gray or red filaments, and are very numerous.

*Q.* What vital properties have these nerves?

*A.* They have neither animal sensibility, nor sensible organic contractility. They have organic sensibility, and insensible organic contractility.



*Q.* What inference is made from the universal existence of these ganglions?

*A.* That they subserve some great though unknown purpose in the animal economy.

*Q.* What views does Beclard add to this nervous system of organic life?

*A.* He does not consider it a settled point, that the sympathetic is an independent nerve; its character may be only that of different organization.

*Q.* What are his views of the relations of the filaments and nerves to the ganglions?

*A.* It is proved that nerves and filaments do pass through the ganglions.

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#### PATHOLOGY OF THE NERVOUS SYSTEMS OF ANIMAL AND ORGANIC LIFE.

*Q.* Name the principal diseases of the brain.

*A.* Inflammation, congestion, softening, hardening, scirrhus, ossification, cartilaginous transformation, fungus, apoplexy, epilepsy, hydatids of the choroid plexus, dilatation of the arteries and veins, effusions of blood and serum, head-ache, diminished volume of the brain.

*Q.* What general observation will apply to many of these affections?

*A.* That many of them are consequences of the acute and chronic inflammations of the brain.

*Q.* What is the first division of the diseases of the nervous system?

*A.* Into those of the nervous system of animal life, and those of the nervous system of organic life.

*Q.* How are the diseases of the animal nervous system subdivided?

*A.* Into the diseases of the brain and those of the nerves.

*Q.* Then what is the division of the diseases of the brain?

*A.* Into the idiopathic or essential, and the symptomatic or consequential.

*Q.* What are the forms of inflammation of the brain?

*A.* They are acute and chronic; but as separate from inflammation of the cerebral meninges—little is known of phrenitis.

*Q.* In the collection of cerebral diseases given above, which are the effects of inflammation?

*A.* A softening, hardening, scirrhus, effusions of blood and serum, and head-ache, and formations of pus.

*Q.* After apoplexy, what parts are most liable to hemiplegia?

*A.* The face and extremities; the trunk is seldom affected with hemiplegia.

*Q.* What does paralysis essentially indicate?

*A.* It is symptomatic of a lesion of the nerves.

*Q.* What is apoplectic stertor owing to?

*A.* To paralysis of the muscles of the larynx.

*Q.* What inference do spontaneous alvine evacuations justify in a case of apoplexy?

*A.* That the bowels and sphincters are losing their contractility.

*Q.* If an apoplectic, bloody effusion takes place in a



young person, what favourable termination often happens?

*A.* The clot is encysted, absorbed, and the cavity finally obliterated by an adhesion of the sides of the cyst.

*Q.* When are bloody effusions found in the brain?

*A.* They are found in the substance of the cerebral mass, not in the exterior, nor in the ventricles.

*Q.* What fluid is usually found in the ventricles and on the external surface of the brain?

*A.* Serum; and when this effusion is superficial, its source is the pia mater, but the serum in the ventricles is always from the arachnoid.

*Q.* What disease does serous effusion in the brain constitute, and what in the spinal canal?

*A.* In the brain it is termed hydrocephalus; in the spinal column it is hydrorachitis.

*Q.* What is the pathology of those head-aches, which, in gastric affections, so severely afflict the forehead and one eye?

*A.* They are sympathetic affections of the mucous membrane of the frontal sinuses, and of the mucous membrane on the eye-ball.

*Q.* How do you divide alienation of mind?

*A.* Into the congenital and acquired.

*Q.* What causes the congenital alienation?

*A.* Organic derangement.

*Q.* What hardening of the brain is most common?

*A.* A white fibrous hardening in the white substance.

*Q.* What alteration in volume does the brain undergo?

*A.* It diminishes, but never morbidly enlarges in its volume.

*Q.* What are the diseases of the nerves?

*A.* They are the tic doloureux, inflammation, convulsive affections, osseous and cartilaginous transformations, atrophy, and hypertrophy.

*Q.* What is the pathology of tic doloureux?

*A.* It is not known, but it has been ascribed to an engorgement of the neurilema.

*Q.* How do you distinguish tic doloureux from rheumatism?

*A.* Tic doloureux does not change its locality, as rheumatism does.

*Q.* How are nervous convulsions distinguished from cerebral?

*A.* The nervous are local in their causation and extent, the cerebral are general.

*Q.* To what diseases are the ganglia subject?

*A.* To atrophy and hypertrophy.

*Q.* What changes are the nerves subject to?

*A.* To ossification and cartilaginous alteration from inflammation.



## VASCULAR SYSTEM.

### I. VASCULAR SYSTEM WITH RED BLOOD.

#### *General Remarks upon the Circulation.*

*Q.* How is the circulation divided?

*A.* Into that conveying red, and that which circulates black blood.

*Q.* Where does the vascular system with red blood commence?

*A.* It arises in the capillaries of the lungs, and ends in the arterial terminals or capillaries throughout the body.

*Q.* Where is the commencement and ending of the vascular system with black blood?

*A.* It has its origin in the general capillary system, and ends in the lungs.

*Q.* What are the channels for conveying the red blood?

*A.* The pulmonary veins; the left side of the heart and arteries.

*Q.* Is there one continued or general membrane in these canals?

*A.* There is; the lining membrane is continued from one capillary system to another. This membranous canal is strengthened on the pulmonary veins by loose membrane, in the heart by its fleshy walls, in the arteries by a dense, fibrous, peculiar coat!

*Q.* What are the channels for the system of black blood?

*A.* The veins, the right side of the heart, and the pulmonary artery.

*Q.* How are the valves of the veins and arteries formed?

*A.* They are formed from the continued lining membrane of these vessels.

*Q.* What is the conspicuous anatomical view to be taken of those two circulations?

*A.* Their entire separation, their distinctness, and the respective origin and terminations of the two in the pulmonary and general capillary systems.

*Q.* What do you mean by their distinct and separate character?

*A.* It is, that separate organization supports them. Even if the right and left sides of the heart were not united, the two functions would readily proceed.

*Q.* At what point in the channels of the respective circulations do you find the greatest collection of blood?

*A.* In the heart.

*Q.* What general arrangement of the channels is worthy of recollection?

*A.* That the vessels which convey red blood from the *commencement* of its circulation to the heart increase in *size* and diminish in *number*; that the vessels which convey red blood *from* the heart to its *termination* increase in *number* and diminish in *size*. The same fact obtains in the arrangement of the vessels conveying black blood, viewing its vascular system as commencing in the general capillaries and terminating in the lungs.

*Q.* What renders the heart necessary in these two red and black blood systems?

*A.* Without it the parietes of the vessels could not convey the blood from one capillary system to another.



*Q.* What then is the use of the heart?

*A.* It is purely to give a mechanical impulse to the blood.

*Q.* Where do you find this impulsive power greatest?

*A.* In that circulation which is the most extensive: the left ventricle has therefore more power than the right.

*Q.* Has the heart any influence on the qualities of the blood?

*A.* It is not probable that any effect is produced on the blood by the action of the heart other than a more intimate mixture of its particles.

*Q.* Can you suppose a case in which the heart could be dispensed with?

*A.* The agency of the heart is required by the extent of the circulations of red and black blood; as these are less extensive, the impulsive influence of the heart will in proportion be dispensed with; in no other view can the idea suggested by the question be admitted.

*Q.* Is there any motion independent of the heart's impulse?

*A.* There is an oscillatory motion as in the branches which terminate in the porta of the liver; this oscillation keeps up circulation in syncope.

*Q.* What are the general uses of the circulation with red blood?

*A.* It supplies the materials for secretion and nutrition. The motion of the arteries which convey red blood is useful in aiding functional action.

*Q.* Does the red blood furnish the material for secretion to every organ?

*A.* To all except the liver.

*Q.* What are the general uses of the circulation with black blood?

*A.* It is a reservoir for the various substances, from within and without, which enter into the venous blood, such as the fluids from the lymphatics, from the thoracic duct, the chyle, &c.

*Q.* Under what circumstances will the chylous vessels take up deleterious substances?

*A.* If the organic sensibility is altered or exalted, these vessels will receive that which in health they would reject. Thus it is with the skin, when it absorbs matters, and they go into the black blood circulation.

*Q.* Bring the circulations into nearer relation.

*A.* The circulation of black blood receives materials into the system, while that of red blood expends them on it.

*Q.* How does this explain plethora?

*A.* If the black blood circulation receives more than the red blood expends, there is plethora; on the contrary, an impoverished state of the humours shows itself when the red blood expends more than the black blood receives.

*Situation, Forms, and General Arrangement of the Vascular System.*

*Q.* Why does gangrene more frequently appear in the lower extremities, than in the head and upper extremities?

*A.* Because in the lower extremities the impulse of the heart in the circulation is weakened, and the free return of blood is opposed by gravity.

*Q.* How is the aorta united to the heart?



*A.* By means of the internal or lining membrane; the fibrous membrane of the aorta does not unite directly with the fleshy substance of the heart.

*Q.* How are the semilunar valves formed?

*A.* By the folds of the lining membrane, and the corresponding festoons of the fibrous membrane of the aorta.

*Q.* What advantage results from the undivided trunk of the aorta descendens?

*A.* The impulsive power of the heart is better preserved over the great length of the branches of the inferior aorta.

*Q.* What is the most accurate estimate of the number of branches and subdivisions of each artery?

*A.* That made by Haller, amounting to twenty.

*Q.* In ramifications from the main trunk of an artery, what favours the current of blood in the branch?

*A.* A projection formed by the folds of the internal membrane of the artery, corresponding with the angle coming from without, breaks the column of the blood and favours the change of its current.

*Q.* Does the tortuous course of the arteries diminish the impetus of the blood?

*A.* From experiments made on animals, it was ascertained that the tortuous course of the arteries does not diminish it.

*Q.* Are anastomoses formed near to the heart, or remote from it?

*A.* They are found distant from the heart, and they are more numerous in those organs whose motions are not controlled in any way by other parts. You see this exemplified in the arteries of the brain.

*Q.* You see the large arteries deep-seated and well pro-

tected, is this protection the only benefit derived by the arteries?

*A.* It is not; for the motions of the parts in which the blood-vessels are imbedded facilitates the passage of blood, and the arterial pulsation itself favours the functional operations and vital activity of the surrounding organs.

*Q.* What are the advantages of the tortuous arterial courses?

*A.* It serves to protect the arteries themselves from injury, in the action of some parts; and again, it in other parts tends to the safety of the organs.

*Q.* What is the use of arterial anastomosis?

*A.* It facilitates the passage of blood into the capillaries, whose vitality being so often deranged are liable to congestion. You are well aware of the value of anastomosis, after taking up principal arterial trunks.

*Q.* Is the sum of the diameter of the branches equal to the calibre of the trunk?

*A.* It exceeds it.

*Q.* Why is aneurism more frequent in the aorta than in remoter parts of the arterial system?

*A.* Because in proportion to the calibre of the artery, the parietes are thinner than in the other arteries.

*Q.* Where do the arteries terminate?

*A.* In the capillaries.

*On the Organization of the Vascular System with Red Blood.*

*Q.* In what arteries is their peculiar coat thickest?

*A.* In the large arteries, and it becomes thinner in the



smaller ones. The inner or lining membrane is uniformly thick in all the arteries.

*Q.* In what considerable arteries is this fibrous coat thin?

*A.* In the vertebral and internal carotid.

*Q.* What, according to Bichat, is the source of cerebral sanguineous effusion?

*A.* He supposes it always to proceed from the capillaries, not from the arterial trunks.

*Q.* What is the organization of this peculiar coat of the arteries?

*A.* It is composed of distinct layers of circular fibres. There are no longitudinal fibres. The coat is yellow.

*Q.* Is this fibrous coat of the same texture with muscle?

*A.* It differs from muscle in its firmness, density, and slight extensibility. The fibrous coat will even break before it will stretch. There is no analogy in their vital properties.

*Q.* What then is this arterial coat?

*A.* Bichat considers it a distinct texture.

*Q.* Why is the arterial structure so strong?

*A.* To sustain the impulse of the heart, so that the arteries shall not dilate so much as to weaken the onward progress of the blood.

*Q.* Does similarity of form alone constitute similarity of texture?

*A.* No—similarity of properties is likewise necessary.

*Q.* How does this differ from the fibrous or peculiar coat of the arteries?

*A.* It is thinner; it is transparent; it has no fibres; it is white.

*Q.* What tendency has this coat in old age?

*A.* To ossification, which occurs most frequently about the aorta and mitral valves.

*Q.* What renders the pulse so intermitting in old age?

*A.* It is probably owing to this ossification of the lining membrane.

*Q.* Does this ossification of the lining membrane equally endanger the old man and the middle-aged?

*A.* That ossification which is not alarming in the old, is exceedingly dangerous to the adult.

*Q.* What cellular investments have the arteries?

*A.* There is a loose cellular envelope which connects them with surrounding parts, and a dense cellular coat.

*Q.* Does cellular substance enter into the organization of the fibrous coat?

*A.* It does not; hence the brittleness of that coat, and its disposition to rupture in aneurism.

*Q.* Why are not absorbents found in the arteries?

*A.* Because in the peculiar and common or lining membrane of these vessels there is no cellular texture.

### *Properties of the Vascular System with Red Blood.*

#### *1. Physical Properties.*

*Q.* What physical property do the arteries possess in an eminent degree?

*A.* Elasticity, and this property distinguishes them principally from the veins.

*Q.* What tubes in the body are kept open by this elasticity?

*A.* The arteries, the trachea, the meatus auditorius of



the foetus. All the other canals approximate their inner surface, and are closed when their distending fluids or contents are taken away.

*Q.* How does a flattened, pressed, or bent artery recover its calibre and form?

*A.* By its elasticity.

*Q.* What do you mean by the locomotion of an artery?

*A.* It is the rising of an artery, and the straitening of its tube, particularly at the curves, when penetrated by blood or injection, and its return to the natural state afterwards. This is principally owing to the elasticity of the arteries; veins manifest no such properties.

*Q.* On what does this arterial locomotion depend?

*A.* To it three circumstances are essential; an impelling power as that of the heart, the tortuosities in the vessels to be strained by the blood impelled, and firm elastic coats.

*Q.* Can you distinguish between arterial elasticity and contractility?

*A.* Elasticity is a physical property, contractility an inherent textural one: elasticity presupposes compression; contractility presupposes the absence of distending contents: elasticity is quick and sudden in its commencement and termination; contractility is slow with a permanent tendency to contract: contractility presumes extensibility; elasticity does not.

## *2. Properties of Texture.*

*Q.* How do the arteries manifest extensibility?

*A.* In two ways; in their diameter and in their length. The longitudinal extensibility is greatest.

*Q.* On what structures do these two kinds of extensibility depend?

*A.* That of the diameter depends on the circular fibres of the peculiar membranes; the longitudinal on the extensibility of the common lining membrane and its folds, for there are no longitudinal fibres in either coat.

*Q.* What results from the limited extensibility of the peculiar or fibrous coat of the arteries?

*A.* Its rupture in aneurism. The more slowly the distention of the peculiar coat is made, the greater the extent to which it may be carried.

*Q.* How is arterial contractility to be divided?

*A.* Like extensibility, it is transverse and longitudinal.

*Q.* Give instances of transverse, arterial contractility.

*A.* The union and closure of the umbilical artery and ductus arteriosus; the emptying of an artery between two ligatures; the closure of a tied artery from the ligature up to the first branch given off; and the diminution of the calibre of arteries in profuse hæmorrhage.

*Q.* How do you account for a small and large pulse?

*A.* The contraction of the artery when empty constitutes the small pulse, and the expansion when full of blood the large one.

*Q.* Are contractility and irritability the same?

*A.* They are entirely different; for contractility is a property of texture, irritability is a vital property. Contractility continues for a long time after death, irritability soon disappears; contractility results from the absence of extension, irritability is the result of stimulus applied.

*Q.* What important consideration do you infer from this distinction?

*A.* The superiority of that system should be well re-



collected, which recognises the marked difference between vital and textural properties.

*Q.* Give an example of longitudinal arterial contractility.

*A.* When an artery is cut across it retracts.

*Q.* In what surgical operation is this kind of contractility conspicuous?

*A.* The retraction of the spermatic artery is remarkable when the cord is cut in extirpation of the testicle.

*Q.* How is this contractility of the artery to be overcome?

*A.* Tie the artery before the vas deferens is cut; and then it does not retract within the ring.

### 3. *Vital Properties.*

*Q.* Do the arteries possess animal sensibility?

*A.* Experiments frequently and variously made prove that they do not.

*Q.* What nerves supply the arteries?

*A.* The nerves of organic life.

*Q.* Is animal contractility a property of the arteries?

*A.* Experiments made on the brain and spinal marrow with a view to ascertain this point prove, that injuries of these organs, while they excite the animal contractility into convulsive action, do not influence the arteries at all: even galvanism failed to do so.

*Q.* What medical doctrine do these experiments contradict?

*A.* The doctrine of the influence of the brain on the arteries.

Q. Do the arteries manifest sensible organic contractility?

A. They do not; irritation, in whatever way applied, cannot excite it. Contractility of texture has been mistaken for sensible organic contractility.

Q. Repeat the organic vital forces of the organs.

A. Sensible organic contractility; insensible organic contractility and organic sensibility.

Q. Do the arteries exercise the two last properties in an eminent degree?

A. Only to obey the requisitions of nutrition; hence these vessels are little liable to disease.

Q. What is liable to be mistaken for inflammation in the arteries?

A. A redness which spontaneously appears in them, particularly in the cerebral arteries, after death.

Q. What would be the consequence if the arteries were equally liable with other parts to disease?

A. Inevitable destruction to the life of the part, and in very many cases general death.

Q. Are the arteries active or passive in this?

A. From the absence of sensible organic contractility it may be supposed they are passive.

Q. Can you assign reasons for believing in the activity of the heart, and the passive state of the arteries in circulating the red blood?

A. These reasons are, the entire difference in the vital forces of the heart and arteries: affections of the arteries do not disorder the pulse, but diseases of the heart do: the artery always ceases to beat below a ligature, except by anastomosis, and this pulsation is from the heart through



the anastomosing branches: cut off a dead man's arm, insert a tube in the brachial artery, place the other end of the tube in the carotid artery of a dog, and the artery in the wrist will be felt: no animal has arterial pulsations except those with hearts, or with a vascular arrangement giving an impulse as the heart does: lastly, the fatal consequences of independent arterial action must be at once evident.

*Q.* Where does the power of the heart over the blood cease?

*A.* In the capillaries, where it changes from red to black blood; it diminishes sooner, but is lost there.

*Q.* With what textures should the arteries be classed?

*A.* With the cartilaginous, fibro-cartilaginous, and fibrous textures.

*Q.* What moves the blood in the capillaries?

*A.* The branches are so minute that insensible organic contractility or tonicity is sufficient to move it.

*Q.* What are the causes chiefly affecting the pulse?

*A.* The increase of the sensible organic contractility of the heart; alterations in the quality of the blood rendering it more or less irritating to the heart; obstructions in the capillary system; all these produce variations in the conditions of the pulse.

*Q.* Are the sympathies of the arterial texture numerous or active?

*A.* The obscurity of arterial vital properties would answer negatively.

*Q.* How do the vital properties of organs generally influence sympathy?

*A.* Sympathies depend on vital properties; mechanical or textural properties have capacity neither to radiate nor receive sympathetic impressions.

*Q.* How is the pulse sympathetically affected?

*A.* Always through the heart.

*Of the Vascular System of Red Blood in different  
Ages.*

*Q.* How does the foramen ovale close?

*A.* By the gradual approach of the concave surfaces of the two crescentic productions forming the foramen ovale, and which unite and decussate at birth, closing the aperture.

*Q.* What closes the ductus arteriosus?

*A.* It closes as the pulmonary artery dilates.

*Q.* Is there red and black blood in the foetus, as in independent life?

*A.* There is not; all the foetal blood is black.

*Q.* What investigations have proved the black colour of the foetal blood?

*A.* Animals have been opened, and the blood of the young examined, and it has proved to be black: the blood of the umbilical arteries is black; the blood of the foetus dead in the mother is always black; this last is a delusive circumstance.

*Q.* Does it follow that the venous blood of the adult, and black blood of the foetus are similar in qualities, because they are so in colour?

*A.* It does not thus obtain. Foetal blood is unctuous in its feel; it does not coagulate in the dead body; it has no fibrin; it does not take the vermilion colour from the air; it has no phosphoric salts.

*Q.* How did Sabatier divide the mass of foetal blood?

*A.* In two circulations; the first is thus laid down:—



The blood of the capillaries of the inferior extremities of the abdomen and umbilical cord, instead of going from the inferior cava to the right auricle, passes to the left auricle through the foramen ovale, and thence through the left ventricle into the carotids and head.

*Q.* Give Sabatier's second division of the foetal circulation.

*A.* It is that the blood returning from the head, passes along the right auricle, ventricle, and pulmonary artery, through the ductus arteriosus into the aorta descendens, thence into the capillary system of the abdomen and extremities, and partly to the umbilical arteries. So that there are two circulations in the foetus, with different origins, trunks, organs of impulse and terminations.

*Q.* In this system of Sabatier, what part of the heart impels the blood to the upper and lower parts of the body?

*A.* The left ventricle propels it to the head; the right ventricle to the lower parts of the body. By the gradual closure of the foramen ovale and ductus arteriosus, the blood takes its channels for life; the change is not a sudden one.

*Q.* Is the arterial system early developed?

*A.* Of course it is, as it conveys nutriment; but the texture is soft, yielding, apparently homogeneic. The arterial strengthens as the heart increases in vigour.

*Q.* What changes take place at birth?

*A.* In the red blood system, two changes take place; the one is mechanical, the other is chemical.

*Q.* What are these mechanical and chemical changes?

*A.* The mechanical are the closures of the foramen

ovale and ductus arteriosus; the chemical change is the action of the air on the blood in the lungs.

*Q.* How does respiration commence at birth?

*A.* In consequence of a general excitement produced on all the moving parts from external impression at birth; perhaps the intercostals and diaphragm are set in motion instinctively.

*Q.* Are you correct in applying the term instinct in this case?

*A.* Yes; for various examples of these instinctive actions at birth can be presented. Observe, the infant prepares its mouth for sucking; animals seek the teats of the mother; gallinaceous animals look for grain, &c. to nourish them.

*Q.* But as the ductus arteriosus is not entirely closed at birth, how is it that blood does not pass through it?

*A.* It is accounted for in two ways; the capillaries of the lungs invite blood through the pulmonary artery, and the vital forces of the duct itself are offended by blood which is not placental; thus the blood goes on to the lungs.

*Q.* How is the foramen ovale closed?

*A.* When the blood passes from the pulmonary veins into the left auricle, one valve of the foramen is pressed on the opening; and when the blood comes from the *cavas* into the right auricle, the two valves are completely united, and kept so till union permanently takes place.

*Q.* Can the foramen ovale remain open and the circulation go on?

*A.* It can. Bichat has repeatedly seen it; for, though open, the auricular contraction so throws the valves of the



foramen into contact, as to close it. Again, the vital forces of the left auricle may, after birth, reject black venous blood; this is the elective operation of the vital forces of the different organs.

*Q.* You have stated the great development of the cerebral arterial system in infancy, where does it predominate at puberty?

*A.* In the genital organs and the lungs.

*Q.* Where is vitality most active in adult life?

*A.* In the viscera of the abdomen.

*Q.* How many kinds of bodily growth are there?

*A.* Growth in height, and thickness; the first ends about the eighteenth year, the second continues till the fiftieth year. When the growth in thickness ceases, the calibres of the arteries no longer increases, and the arterial development has no local preponderance.

*Q.* What takes place in the arterial system of old age?

*A.* The blood is sent with diminished force to the small arteries; they gradually close and are obliterated.

*Q.* What are the two great offices of the circulation of red blood?

*A.* To impart nutrition, and excite the organs by the arterial motion.

*Q.* Under what circumstances are the arteries accidentally developed?

*A.* When their natural course is obstructed; in tumours; in pregnancy. Painful tumours, or those in which there is an exalted animal sensibility, produce this development more than indolent tumours.

*Q.* Does Beclard believe that the arteries do not possess sensible organic contractility?

*A.* He is of opinion, with several experimenters subsequent to Bichat, that they do exercise that vital property.

*Q.* Is this sensible organic contractility most conspicuous in the large or small arteries?

*A.* In the smaller ones, because of the great nervous power distributed to them.

*Q.* Why do you think that the arteries aid the flow of blood?

*A.* Because the flow from an artery is constant; if it were dependent on the heart alone, the blood would flow only when the ventricle contracted.

*Q.* Why do you suppose the arteries to be self-developed?

*A.* Because vessels exist before the heart does.

*Q.* Which arterial coat is most liable to inflammation?

*A.* The internal; in abdominal and thoracic inflammation, the lining membrane of the aorta is found red and inflamed.

*Q.* Name the organic alterations of the arteries.

*A.* Inflammation, aneurisms, ossification, cartilaginous transformation. Ossification frequently brings on the gangrene of old persons.

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#### PATHOLOGY OF THE VASCULAR SYSTEM WITH RED BLOOD.

*Q.* To what diseases are the arteries liable?

*A.* The diseases of the arteries are few. They are inflammation of the lining membrane, dilatation of the artery without lesion, contractions of the arteries, ossification, and aneurism.



*Q.* Can you give a remarkable fact illustrating the disposition of the arteries to disease?

*A.* This is one; that they are so constantly found uninjured while all the surrounding parts are destroyed.

*Q.* What appearances during life and after death indicate inflammation of the lining membrane of the arteries?

*A.* There are no conclusive symptoms during life; and after death the membrane is of a high red colour, somewhat thickened, and is said to be more brittle.

*Q.* Where do you see dilatation of the arteries without lesion?

*A.* It has been seen general and partial; the coats thicken in proportion to the increase of the size of the artery.

*Q.* What do you remark of the contraction of the arteries?

*A.* It is also general or partial. The first arises when the vital forces, general and arterial, are much diminished; the partial is seen in the large arterial trunks.

*Q.* What coat is most liable to ossification?

*A.* The internal membrane.

*Q.* At what age does this ossification occur?

*A.* Principally in the aged.

*Q.* How does it affect the pulse?

*A.* It renders it intermitting and irregular.

*Q.* Where is aneurism oftenest seen?

*A.* About the curvature of the aorta; next to that in the abdominal aorta.

*Q.* What is a true aneurism?

*A.* An arterial dilatation, where the external coat is ruptured, although the middle and internal may be burst.

*Q.* Define a false aneurism.

*A.* It is a collection of blood in the surrounding cellular texture from rupture of the arterial coats.

## II. VASCULAR SYSTEM WITH BLACK BLOOD.

*Situation, Forms, Division, and General Arrangement.*

Q. How is this system divided?

A. Into two distinct ones. The general black blood system, and the black blood system of the abdomen.

Q. What proof is there that blood is not formed in the general capillary system?

A. The fact that no veins arise from parts where arteries are not sent.

Q. What are the two orders of veins?

A. Those which accompany the arteries, and those which are superficial, sub-cutaneous.

Q. Where do the veins originate?

A. From the general capillary system.

Q. Is the arterial system or the venous most capacious?

A. The venous is much more capacious than the arterial; there is no fixed disproportion.

Q. On what does the continuance of the circulation depend?

A. On a due relation between the capacity of the systems of red and black blood, and also between the velocity with which the blood is propelled; and on a similar relation between the origins, agents of impulse, and terminations of the two circulations.

Q. Which side of the heart contains most blood after death, and what is the reason?



*A.* The black blood side of the heart; and the reason is that the circulation ordinarily stops first in the lungs, and the blood is by this pulmonary obstruction, collected in the right side of the heart.

*Q.* Why is there weakness of parietes, slowness of motion, and great capacity in the veins?

*A.* The parietes are comparatively weak, because the veins have little impulse to support; the velocity is not so great as in the arteries, because the force of the heart is so little felt in the veins; the capacity is great in the veins that they may bear accumulations from gravity and other causes with safety.

*Q.* What is the result of a diminution of the velocity of the blood in the veins?

*A.* It increases the capacity of the veins; hence the difference in the capacity of the veins of the inferior and superior extremities.

*Q.* What is the principal point of difference in the branches of the veins and arteries?

*A.* The venous are much less tortuous, and hence there is no locomotion in them.

*Q.* Where are the *ramifications* and small *branches* of the veins usually found?

*A.* The ramifications form a constituent part of the interior of an organ: the branches lie in the interstices, lobes and circumvolutions of the organs.

*Q.* Why are the large arterial and venous trunks deep-seated?

*A.* To preserve them from injury.

*Q.* Considering the venous system as a whole, what three trunks compose it?

*A.* The cava superior, the cava inferior, and the coronary vein.

*Q.* What difference is there between the communications of the arteries and of the veins?

*A.* The venous are much more numerous than the arterial; the first form reticular anastomoses, such as are not seen in the latter.

*Q.* How do you explain the continuance of the venous circulation, when the sub-cutaneous veins are tied or otherwise obstructed?

*A.* The free communications between the superficial and deep-seated veins account for it.

*Q.* Name one great distinctive mark between the red and black blood circulation?

*A.* The influence of gravity in the venous circulation.

*Q.* What arrangement is particularly destined to counteract this gravity?

*A.* The valves of the veins.

*Q.* Why is gravity so powerful in the veins?

*A.* Because there is no agent of impulse at the origin of the black blood circulation in the general capillary system.

*Q.* What is the office of the vena azygos?

*A.* To anastomose between the superior and inferior cava. This free anastomosis precludes the idea of hepatic pressure on the cava producing dropsy; the blood finding its way through the azygos.



*Organization of the Vascular System with Black Blood.*

Q. Of what is the peculiar membrane of the veins composed?

A. It is a fine layer of longitudinal fibres.

Q. Where is this membrane most conspicuous?

A. In those veins where gravity is the most operative; and in the superficial veins where pressure does not aid the circulation as in the deep-seated veins. These fibres can be better seen in the branches than in the trunks.

Q. What is Bichat's opinion of this membrane?

A. That it is a texture sui generis.

Q. What distinguishes it from the arterial coat?

A. The absence of elasticity and brittleness; its softness; its great extensibility of texture; and the longitudinal direction of its fibres. There are no circular fibres in the veins.

Q. Where is this peculiar membrane found wanting?

A. In the sinuses of the dura mater there is neither the cellular coat nor fibrous membrane; the venous coats there are the dura mater and common lining venous membrane.

Q. How does the common membrane of the black blood system differ from that lining the arteries?

A. It is more distensible, it is more delicate, it never ossifies. Hence you do not see ossification in the right side of the heart.

Q. Where does Beclard say the venous valves are most numerous?

A. In the superficial veins; in those of the inferior extremities.

Q. In what part of the venous system are there no valves?

A. There are none in the pulmonary veins, except just

at the heart; they are wanting in the trunk of the cava ascendens, in the emulgent veins, in the cerebral sinuses. See Horner, Vol. II. p. 158.

*Q.* How are the venous fibres best exhibited?

*A.* By plunging the veins into boiling water or concentrated acids, the horny hardening contraction takes place, and the fibres are seen.

*Q.* What distinguishes the venous parietes from the arterial?

*A.* The penetration of cellular texture between the fibres of the peculiar coat of the veins, into the common lining membrane. This is not seen in the arteries. The cellular coat of the veins is peculiarly filamentous.

*Q.* To what extent do exhalation and absorption take place in the veins?

*A.* Only to subserve the purposes of nutrition.

*Q.* Are the veins as abundantly supplied with nerves as the arteries?

*A.* They are not; a few ganglionic nerves supply them.

*Q.* What induces you to believe that the nerves have no effect on the contraction of the left side of the heart?

*A.* The fact that the right side is as abundantly supplied with nerves as the left. We would therefore suppose that nervous influence does not confer the difference of ventricular power.

### *Properties of the Vascular System with Black Blood.*

#### *1. Properties of Texture.*

*Q.* Are the veins extensible?

*A.* They are, but in a transverse direction; the arteries are so longitudinally.

*Q.* Have not recent investigations proved that the veins are extensible longitudinally?



*A.* They have; Puschett, a German, has seen them become tortuous and longer in disease.

*Q.* Are the veins easily or frequently ruptured?

*A.* They are; for example, the hæmorrhoidal, the cephalic; even the jugular and cava veins have been ruptured. Call to mind the thin parietes of the cephalic veins.

*Q.* Is the venous texture contractile?

*A.* Evidently so. The contractility is slight in the longitudinal, much greater in the transverse direction.

*Q.* What circumstances affect this contractility?

*A.* Seasons of the year, posture of the body, cold or hot applications, and period of life.

## 2. *Vital Properties.*

*Q.* Have the veins animal sensibility and contractility?

*A.* Bichat says that experiments prove them destitute of these properties.

*Q.* Does not Beclard allow the veins vital contractility?

*A.* Yes; various experiments, he says, prove that the veins in the living, contract in a manner not seen in dead bodies; hence it is a vital, not a textural contractility.

*Q.* Do the veins possess sensible organic contractility?

*A.* They do not; for in disease the veins manifest none of those evidences of increased sensible organic contractility which the heart, stomach, or bladder give out.

*Q.* What light does disease throw on the predominant vital forces of our organs?

*A.* Diseases exalt those that are predominant, so as to show those that prevail in the different organs in health.

*Q.* How does Bichat account for the venous pulse?

*A.* He ascribes it to a reflux of blood from the right

side of the heart, in consequence of pulmonary obstruction, or of an irregular action of the heart. These occasion a psuedo-pulsation, resulting from the contractility of texture, not from irritability.

*Q.* How far is this reflux operative?

*A.* Rarely beyond the great trunks; it is stopped by the valves. Haller said it extends to the iliacs.

*Q.* Why do wounded veins inflame and unite so much more speedily than arteries?

*A.* Because the tonic vital forces are greater in the veins than arteries, because the action of the arteries may prevent union, and perhaps because there is more cellular texture in the veins than in the arteries.

*Q.* How is the blood moved from the general capillaries through the veins?

*A.* By the insensible contractility of the capillaries; by an absorbing power which commences in the venous ramifications, and extends towards the venous trunks.

*Q.* But as the resistance to the motion of the blood in the veins is often greater than the impulse, how does it get forward?

*A.* By various aids; by anastomoses; by muscular action and pressure; by assistance from the pulsation of the neighbouring arteries; by the motion of certain parts, as the elevation and depression of the cerebral mass; by the locomotion of other organs, as the gastric; and by external frictions and motions.\*

*Q.* Can you give a parallel view of the circulation in the arteries and veins?

\* For a more particular account of the forces, by which the blood is made to circulate in the veins, see Arnott's Elements of Physics, American Edition, p. 446, et seq.



<i>A.</i> In the arteries there is	In the veins there is
Pulsation,	No pulsation,
Rapid flow of blood,	Slow motion of the blood,
Small capacity and	Great capacity and thin
thick parietes,	parietes,
No necessity for ac-	Necessity for accessory
cessory aid,	aid,
Blood flowing per	Uniform flow of blood,
saltem,	
Very little arterial	Power of gravity in the
gravitation.	veins.

*Q.* What are the effects from an organ of impulse at the origin of the arteries?

*A.* It gives uniformity of pulsation or motion in the arteries, and you find all the arteries of the body equally dilated or contracted after death.

*Q.* Now, what results proceed from the absence of an organ of impulse at the capillary origin of the veins?

*A.* The blood is propelled with very various power in different parts of the body; and there is great variety in the states of fulness or contractions of different veins in the several parts of the body.

### *Development of the Arterial System with Black Blood.*

*Q.* Is the arterial or venous system most developed in foetal life?

*A.* The arterial much more so; less blood returns by the veins, because of the quantity exhausted by nutrition.

*Q.* What veins have been found developed before the arteries?

*A.* The umbilico mesenteric in the chick.

Q. Why are varices rare in foetal life?

A. Because the venous coats are very strong at that period; more so in proportion than in after life.

Q. What alterations take place in the veins of old age?

A. A dilatation of their parietes, a diminished contractility in the capillaries, a diminished velocity in the mass of venous blood from an increased capacity in the veins.

Q. How does Bichat account for the quantity of blood in old age?

A. As decomposition prevails over nutrition in advanced life, and the veins receive the decomposed matter, they contain a greater quantity of blood.

Q. Where are varices principally found?

A. In the inferior extremities of old persons, and of pregnant women; the causes are obvious.

Q. Why are the veins enlarged in cancer, fungus, &c.?

A. The arterial deposition being increased, the venous fulness is in proportion augmented.

Q. Why is the capacity of the veins enlarged in ascites?

A. Because their coats have lost a measure of their elasticity.

Q. What would be the effect on the circulation, if the blood went from the ventricles by two arterial orifices?

A. There would be neither unity of impulse, uniformity of course, or simultaneous pulsation. These are all preserved by the single aortal trunk.

### *Of the Abdominal System with Black Blood.*

Q. What organs supply this vena portal circulation?



*A.* Those concerned in digestion.

*Q.* Name those organs or parts which do not pour their blood into this vena portal system.

*A.* The kidneys, ureters, bladder, genital organs, diaphragm, and abdominal parietes, do not empty their blood into the vena portarum.

*Q.* Do the properties, sympathies, and affections of this abdominal venous system agree with the general venous system?

*A.* They do.

*Q.* What membrane is peculiar to the hepatic portion?

*A.* That which is termed the capsule of Glisson; the use of which is unknown.

*Q.* What proof is there that the injection of air into the veins is not fatal by impression made on the heart?

*A.* Because injection of air into the abdominal system with black blood is not fatal, and yet the air must reach the heart.

*Q.* How then does air prove fatal when thrown into the blood-vessels?

*A.* By its action on the brain. In the case alluded to in the last question, the air becomes so united, diluted, &c. before any of it reaches the brain that its power is lost.

*Q.* How does the common lining membrane of this abdominal system, differ from that of the general venous system?

*A.* It has no valves; these are unnecessary, because the course of the blood is short. There is no agent of impulse in the middle of this system, as you see in the right side of the heart; the effect of such an agent might occasion a reflux as the action of the right ventricle does.

*Q.* Is the course of the blood uniform through the liver?

*A.* The want of impulse, the solidity of the liver, the absence of hepatic dilatation and contraction, all render the circulation much more uniform than it is in the lungs where the black blood system terminates.

*Q.* Do the coats of the abdominal veins differ in strength from those of the general circulation?

*A.* They are of the same firmness.

*Q.* What aids the circulation of blood through the abdominal veins?

*A.* The movements of the diaphragm and abdominal muscles; the motion, dilatation and contraction of the hollow viscera; the constant motion of the intestines. You will observe that in the hæmorrhoidal veins, that not having these aids in their circulation, there are very frequent varicose enlargements.

*Q.* What induces the belief that the liver performs some very important though unknown office in the system?

*A.* The great disproportion between the size of the liver and its excretories and reservoirs, and that of the kidneys, salivary glands, pancreas and their emunctories; the greater flow of secreted fluids from the last mentioned viscera than from the liver, although that is in size greater than all of them collectively taken; the fact that the liver is universally found in animals; the early foetal development of the viscus, its being coeval with the heart and brain; the great influence the passions have over it; the conspicuous part it performs in the diseases of the œconomy; the influence of the liver on temperaments; its frequent organic diseases; all these impose the belief suggested in the question.

*Q.* Does the liver effectuate any change on the vena portal blood?



*A.* Experiment proves that it does not.

*Q.* What are the evidences that bile is exclusively formed by the vena portal blood?

*A.* This remains but a plausible hypothesis; there is no positive proof of the fact. Bichat thinks that both the vena portal blood and that of the hepatic artery concur to form the bile.

*Q.* Does the blood of the vena portarum differ from the black blood in the general system?

*A.* It has been so supposed, but the reasons are exceedingly doubtful in their character.

*Q.* Does the slow motion of the blood in the vena portarum favour the biliary secretion?

*A.* As this sluggish circulation does not appear in other organs, there is no reason to believe it necessary or conducive to the hepatic secretion.

*Q.* What proof is there that the spleen does not send matter essential to the formation of bile?

*A.* Because, where the spleen is wanting, or removed, bile has been formed in the usual manner.

*Q.* Is the flow of bile into the duodenum constant?

*A.* The hepatic flows constantly; the cystic only during intestinal digestion.

*Q.* Does Bichat suppose that bile exists in the stomach?

*A.* From experiments made on animals he believes that bile is always in the human stomach; and that it is hepatic, not cystic bile, which is found there.

*Q.* At what stage of life does the liver receive most blood?

*A.* In the foetal period.

*Q.* What difference does birth make in the circulation of the liver?

*A.* But one kind of blood enters, and less of that; an interruption to all communication between the general and abdominal black blood system takes place, and a diminished size of the liver.

*Q.* At what period of life is the circulation in the abdominal system of black blood most active?

*A.* From the thirtieth to the fortieth year; and it is at that period that diseases of the abdominal system appear.

*Q.* What are these diseases?

*A.* Hæmorrhoidal affections, and melancholia.

*Q.* Do you ever see ossification in this system?

*A.* Never.

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#### PATHOLOGY OF THE VASCULAR SYSTEM WITH BLACK BLOOD.

*Q.* What are the diseases of the veins?

*A.* They are few, and imperfectly understood. There is inflammation or phlebitis; dilatation; contraction; and concretions in the veins.

*Q.* Name a remarkable pathological contrast in the state of the arteries and veins in fever.

*A.* While the arteries are in tumultuous action, the veins are quiet as in health.

*Q.* What are the causes of inflammation of the veins?

*A.* The cause is sometimes unknown; usually it arises either from wounds of the veins, or from ligatures, as in varicose veins after an operation, or from inflammation of surrounding tissues, or from a varicose state.



*Q.* What are the appearances of an inflamed vein on dissection?

*A.* There is some redness of the inner coats, with thickening of the outer tunics. Pus forms on the exterior coats, and lymph on the internal coat in phlebitis.

*Q.* In what direction does venous inflammation extend?

*A.* In general between the orifice or puncture and the heart.

*Q.* How are venous dilatations divided?

*A.* Into local and general; and into those of the general venous and those of the vena portal system.

*Q.* What are these dilatations called?

*A.* Varices in the general venous system; and hæmorrhoids when they appear in the vena portal system near the rectum.

*Q.* What is the appearance of a varix?

*A.* It is a blue soft tumour, which increases in proportion to the compression between it and the heart.

*Q.* What causes a varix?

*A.* It occurs when the coats of the vein cannot maintain the gravity of a column of blood.

*Q.* Where are these varices most frequent?

*A.* In the spermatic veins, and those of the inferior extremities. They are seldom seen in the superior parts of the body. I have seen an enormous dilatation of the left jugular vein, from obstruction to the passage of blood from the right side of the heart.

*Q.* How many kinds of hæmorrhoidal dilatations?

*A.* Two; one with rupture of the venous coats; the other without. There are hæmorrhoids from which the

blood is evacuated externally ; this is a species of the first form.

*Q.* What is an aneurismal varix?

*A.* The case where there is an abnormal direct communication between the artery and vein.

*Q.* How are contractions of the veins induced?

*A.* By chronic inflammation and thickening of the venous parietes.

*Q.* Where are venous concretions seen?

*A.* They have been seen in the pelvic veins, about the size of a pea.

*Q.* What great difference is there in the pathological tendencies of the internal membrane of the veins and that of the arteries?

*A.* The venous is not disposed to ossify, the arterial is.



## CAPILLARY SYSTEMS.

*Q.* What are the two capillary systems?

*A.* The general capillary system, which is the seat of the alteration of the red to the black blood; and the pulmonary capillary system in which the blood is converted from black to red blood.

*Q.* Whence the great importance of these capillary systems?

*A.* They are the seats of the most important functions, such as nutrition, secretion, digestion, absorption, exhalation; the capillary circulations are governed by peculiar laws; their tubes are the seats of inflammation, metastases; and animal heat is engendered there.

*Q.* In what animals are these systems exclusively the organs of circulation?

*A.* In the lowest classes of animals.

### I. GENERAL CAPILLARY SYSTEM.

*Q.* What is the extent of this?

*A.* All the organs are composed of myriads of capillaries, intercommunicating in every possible way; arterial and venous ramifications pass into the interstices of the organs; the organs themselves are composed of capillaries.

*Q.* Do you say that the capillaries are a class of vessels distinct from the blood-vessels?

*A.* Not only so, but they give rise to the exhalents and

absorbents. The capillary systems are intermediate between the arteries and veins. Nutritive matter for all the organs is by them separated from the blood.

*Q.* How are the general capillaries divided?

*A.* There are those which carry red blood; those which convey white fluids; and those giving passage to both red and white fluids.

*Q.* In what systems do the capillaries with red blood predominate?

*A.* In the muscular tissue, in the spleen, in portions of the mucous system, as the pituitary membrane.

*Q.* In what systems do the blood and other fluids also circulate?

*A.* In the capillary systems of the osseous, serous, some of the fibrous, the dermoid, and glandular tissues, besides others.

*Q.* How is this mixed circulation proved?

*A.* By the comparison of a piece of healthy serous membrane in health and the same in a state of inflammation: by injecting the capillary system of the serous membranes it exhibits a net-work of vessels not apparent in a natural state: the appearance of the inflamed conjunctiva is a remarkable illustration of the question proposed. The proportions of the red and white capillaries vary in different textures; there are fewer red capillaries in the serous tissues, while in the dermoid and mucous tissues they preponderate greatly.

*Q.* What hypothesis has Bichat connected with this?

*A.* That there may be a set of empty vessels, which in a natural state do not convey blood, but which are prepared to receive it in cases of emergency.

*Q.* What organs have white capillaries exclusively?

*A.* Tendons, cartilages, hair, some ligaments.

*Q.* How do you prove the existence of any capillaries in these?

*A.* Injections and disease prove it; these tissues are really vascular.

*Q.* On what does the number of capillaries in a part depend?

*A.* It depends on the functions they perform. Those having few capillaries, such as cartilage, have only nutrition to support; others have exhalation and absorption; and others again have, superadded to all these, secretions to form.

*Q.* What is the pathological distinction between active and passive increased secretion and exhalation?

*A.* Preceding the active there is an increased afflux of blood; in the passive this is not the case.

*Q.* What do you mean by an active secretion or exhalation?

*A.* One attended with an increase of the vital forces; in the passive forms there is a diminution of these forces.

*Q.* Give a definition of the general capillary system?

*A.* It is a general net-work, which communicates in every organ, and from one organ to another; forming in this way free communications for the fluids of the body from head to foot.

*Q.* How does this view affect the usually admitted attributes of the cellular texture?

*A.* It has been thought that the permeability of the body depended on the cellular texture, but here you see it ascribed to the capillary system.

*Q.* Do the capillary vessels conveying red and white fluids freely communicate?



*A.* They do very freely wherever they are met with.

*Q.* What is the pathology of hæmorrhage?

*A.* It is an active or passive *exhalation* of blood, as the case may be; it is not from rupture of vessels.

*Q.* What relation does this general capillary system bear to the arteries and veins?

*A.* It is a general reservoir, into which arteries pour red blood, and from which the veins take black blood; from which also the exhalents with nutritive and other matters pass; the excretions arise from it; the secretory vessels elaborate their fluids from the blood in the general capillary system.

*Q.* What proves this distinct organization or continuity of tubes?

*A.* The continuity from the arterial, through the capillary, to the venous system, is proved by the fact that injections from the arteries do not pass into the cellular texture.

*Q.* What effect has this permeability of the capillary system on the appearances of parts on dissection?

*A.* Before death, tonic action preserves the fluid in a precise part; hence in membranous inflammation the redness. But after death, these fluids obeying gravity, the parts lose the redness which indicates inflammation, and the dissector may imagine there was none. Local irritation, which fixed blood in a part during life and disease, disappearing after death, the blood is removed.

*Q.* Does blood disappear equally after death from chronic as from acute inflammation?

*A.* It does not; in chronic it is more fixed, forming almost a constituent part of the tissue.

*Q.* Why is it, that while the capillary tubes are free and every where open, the blood does not pass into all?

*A.* A general physiological reply may serve, viz. that the organic sensibility of different organs admits certain matters, and rejects all others. Such is the case with the trachea and lacteals, and many others.

*Q.* How then is there an occasional increased flow of blood to a part?

*A.* Irritation applied to that part, increases the organic sensibility, and thus more blood appears in, or is invited to it.

*Q.* What is the great difference between organized and inert tubes or vessels?

*A.* The vitality of the organized, and the inert being under the influence solely of mechanical laws.

*Q.* Where is it that organic sensibility varies most, and thus affects the course of the blood?

*A.* This takes place in the capillary system; not in the large vessels.

### *Of Inflammation.*

*Q.* What is the first step in the pathology of inflammation?

*A.* An alteration and increase of the organic sensibility, in consequence of an irritant to the part.

*Q.* How is this local irritation produced?

*A.* By direct irritation, or by organic continuity, or by sympathy.

*Q.* What is the second step in the process of inflammation?

*A.* An irritation of blood by the increased organic sensibility, and a remora of blood while irritation continues.



*Q.* How is pain produced in inflammation?

*A.* By the alteration and increase of organic sensibility into animal sensibility, which last is perceived by the brain. The impression of the blood on this increased organic sensibility gives pain.

*Q.* How is heat evolved in inflammation?

*A.* It is a result of the alteration of the organic vital forces.

*Q.* What do you mean by a greater or less degree of inflammation?

*A.* An indication of the extent in the increase and alteration of the organic sensibility.

*Q.* You speak of an alteration as well as an increase of the organic sensibility, will you explain this?

*A.* By a simple increase of this organic sensibility, inflammation is produced; by an alteration of the sensibility the inflammation is modified.

*Q.* How do the fluids become putrid?

*A.* To make this change in the fluids, a previous destruction of the vital forces of the part is essential.

*Q.* How do local affections modify fever?

*A.* Bichat supposes that each local affection has its appropriate general fever.

*Q.* What leads to different terminations in inflammation?

*A.* Changes in organic sensibility; reduction of animal sensibility; exhaustion of organic sensibility, according as it ends in resolution, suppuration, scirrhus, or death.

*Q.* Why is the agency of the nerves rejected as inducing inflammation?

*A.* In the system of Bichat, the nerves are allowed no control over organic sensibility, in the changes of which inflammation consists.



*Q.* What relations do the black and red blood bear to inflammation?

*A.* When the inflammation is active, the red blood is found in the capillaries; when the inflammation is passive, black blood is in them.

*Q.* In what tissues is inflammation most frequent?

*A.* In those tissues where there are the greatest number of capillaries, such as the mucous and serous. It attacks those tissues where the functions of the capillaries are most diversified, that is, where nutrition, secretion, exhalation and absorption exist. Where nutrition is only in existence in the capillaries of a tissue, inflammation is comparatively rare.

*Q.* What accounts for the different aspects of inflammation in the various tissues?

*A.* The varieties in the organic sensibility of these tissues.

*Q.* What inflammation prevails in the cellular texture?

*A.* The phlegmonous form.

*Q.* What inflammation is most common in the skin?

*A.* The erysipelatous.

*Q.* What is the inflammation observed in the mucous tissue?

*A.* It is the catarrhal.

*Q.* Do the fluids formed in the terminations of these inflammations differ?

*A.* They do. The pus of phlegmon differs from that of erysipelas. There is no resemblance between the fluid of catarrh, and the flaky fluids from the serous surfaces. The fibrous tissue does not suppurate.

*Q.* Is there a peculiarity of structure in the capillaries of the various organs?

*A.* It is probable that they partake of the structure of the different organs; that they have peculiar organic sensibility, and insensible organic contractility, and consequently peculiar diseases.

*Of the Capillary Circulation.*

*Q.* What are the features of this?

*A.* Two conspicuous ones invite attention; they are the motions of the fluids, and the alterations they undergo.

*Q.* What are these fluids?

*A.* The blood, which is known; the other fluid in capillary circulation is unknown.

*Q.* How are the fluids circulated in the capillaries?

*A.* Not by the heart; but the fluids coming in contact with the capillaries, excite through their organic sensibility, the insensible organic contractility which propels them.

*Q.* What objections are there to the doctrine of the heart's agency in the capillary circulation?

*A.* The vessels of the capillary circulation exhibit a motion different from that of the heart and arteries; where the heart's action is increased, the exhalations are not, and the secretions are actually diminished; in some hæmorrhagies the pulse is very weak; the existence of local external diseases, and the inequality of growth in different parts; all these invalidate the doctrine alluded to in the question, and substantiate the opinion that the capillaries act independently.

*Q.* Founding the division on the circulation of the blood, and that of the capillaries, how do you divide diseases?

*A.* Into those which involve the general circulation, and those which belong to the capillary.

*Q.* Give examples of these.

*A.* Fever is a disease of the general circulation, while the capillaries are the seats of eruptions, tumours, and inflammation.

*Q.* To what classes of animals are fevers confined?

*A.* To those with large vessels, in which the blood moves in mass; where there is no other circulation than capillary, fever cannot exist.

*Q.* Which is the most essential circulation?

*A.* The capillary, for there is no organized being without it, but there are those without the larger or general circulation.

*Q.* When there is irregular motion of the blood in the capillaries of one part, how is the relation between the veins and arteries preserved?

*A.* When obstructed in one part of the capillary system, the determination of blood to another portion of that system is increased.

*Q.* Is the whole capillary system ever affected?

*A.* No—death is the inevitable result of such a state.

*Q.* What is a most important law of the vital forces?

*A.* That when increased in one part, it is necessarily at the expense of other parts.

*Q.* How do you account for the uneasy sensations experienced under atmospheric changes?

*A.* They are the effects of greater or less atmospheric pressure on the equilibrium of internal and external capillary circulation.

*Q.* What important principle as to blood-letting results



from this separate view of the general and capillary circulation?

*A.* That by general blood-letting you do affect the general circulation, but at the same time you do not necessarily remove local irritation or capillary congestion.

*Of the Capillaries considered as the seat of the production of Animal Heat.*

*Q.* What is Bichat's theory of animal heat?

*A.* That caloric is taken in the processes of digestion, respiration, and perhaps by cutaneous absorption; in the general circulation it is combined; in the capillaries it is evolved, giving out animal heat. Thus it is with nutritive matter; it is taken in, combined with the general, and separated in the capillary system.

*Q.* What then is the process of animal heat?

*A.* It is a function of the general capillary system.

*Q.* How is this explanation more probable and rational than the chemical, and mechanical theories of heat?

*A.* It is founded on a uniformity in the operations of physiological nature.

*Q.* Is animal heat greater in animals that respire?

*A.* It is; and the size of the lungs seems to influence the temperature.

*Q.* Does pathology confirm this theory of animal heat?

*A.* It does; animal heat is dependant on the state of the vital forces; and when these forces are increased in inflammation and in disease, the heat is increased. On the contrary, in those cases where the vital forces are diminished, the heat is lessened.

*Q.* Have the tissues different temperatures?

*A.* They have. There is less in the hair, nails, epidermis. There is less heat in the white organs than in the red.

*Q.* If this be the case, how is the general temperature uniform?

*A.* The tissues which evolve much caloric supply those which do not eliminate so much.

*Q.* How do you account for the peculiar sensations of heat in the different tissues?

*A.* Each has its peculiar heat, as it has of secretion. All these varieties result from the modification of the vital forces of the part. Animal bodies alone exhibit these varieties of heat.

*Q.* How is the heat increased in the action of fever?

*A.* By the shock given to the capillary system, increasing its insensible organic contractility.

*Q.* Why is heat increased by hurried respiration?

*A.* Because the circulation is likewise increased, and consequently the vital forces of the capillaries. The material of heat is more freely absorbed in hurried than slow respiration.

*Q.* Is all the heat of red blood lost in its change to black blood?

*A.* It is not; hence in cases of sudden death from asphyxia for example, heat remains some time after death.

*Q.* Why does heat remain longer in sudden than slow death?

*A.* Because in sudden death the great functions are interrupted, but the tonic forces remain for some time.

*Q.* Mention some of the effects of sympathy on animal heat.

*A.* In syncope it is greatly reduced; in phthisis the hands and feet burn; in fever the heat is locally or generally increased. Now, in all these cases, the vital forces of the parts are sympathetically changed.

*Q.* How do you account for the *sensations* of heat in a part which are so delusive, that the parts to a bystander feel cold?

*A.* This is a sympathy of animal sensibility; whereas actual increase of heat is a sympathy of organic sensibility.

*Q.* Why in the natural state of the body is only a certain temperature developed?

*A.* It is not known; nor is it known why the pulse beats a given number of times in a minute, nor why a certain number of respirations are made in the same time. It may be said that this is the primitive order of the vital actions.

## II. PULMONARY CAPILLARY SYSTEM.

*Q.* What do you mean by this pulmonary capillary system?

*A.* Exclusively the system of vessels between the pulmonary artery and the pulmonary veins.

*Q.* In regarding this system, what distinction is to be drawn?

*A.* That it be not confounded with the capillaries between the bronchial arteries and veins; they are attached to the general capillary system.



*Q.* Considering the difference in capacity between the general capillary circulation, and that composing the pulmonary capillary system, how do all the blood of the first and the chyle and the lymph, pass through the second or pulmonary system?

*A.* Recollect first that all the fluids in the general capillary system are not blood; that much of the blood in the capillaries is expended in the functions of the parts through which it passes, as in secretion, exhalation, and nutrition; that the course of the blood is irregular in the general, but direct in the pulmonary capillary system from the arteries to the veins; that the blood in the pulmonary capillaries has no function to subserve; that blood flows much more rapidly and uninterruptedly from the right ventricle to the left auricle, because the course is shorter and more direct, than from the left auricle through the body to the right ventricle; that the blood gains in time of passage what is wanting in capillary space.

*Q.* Why are the lungs so frequently inflamed?

*A.* Because of direct exposure to irritation in respiration, and because of their active sympathies with other tissues, especially the skin.

*Q.* Does the red or black blood become congested in the lungs, in their inflammation?

*A.* It is reasonable to believe that, from the sudden manner in which extensive congestions appear in the lungs, that the bronchial arteries could not supply them; it is therefore the black blood which accumulates in congestion.

*Q.* How can this crowding of the lungs with sanguineous congestion be ascertained?

*A.* By percussion.

Q. What predisposes the lungs to hepatization?

A. The readiness with which they receive large quantities of fluid.

Q. Is it blood which fills the lungs in disease?

A. It is not; for on pressing diseased lungs, the fluid will be white, or even purulent.

Q. Are sacs of pus, or vomicæ, frequently found in the lungs?

A. They are rare; the pus is effused into the substance of the lungs.

Q. Does the blood, in inflammation of the lungs, enter vessels naturally conveying white fluids?

A. It is not certain that there are such vessels in the lungs; it is most probable that the blood engorges its accustomed channels, or it is exhaled into the pulmonary texture, overwhelming its functions.

Q. How does the whole blood of the body pass through the destroyed lungs, in phthisis pulmonalis?

A. The quantity of blood in the body is diminished in proportion as the pulmonary lesion progresses; an evidence of this diminution of the quantity of blood is found in the feeble pulse.

Q. What would be the consequence of transfusing blood into the vessels of phthisical persons?

A. The lungs could not bear any disproportion of blood, induced in that way.

Q. Would the same objection apply to transfusion in hæmorrhage?

A. It would not, because in that case there is simply a want of fluid without lesion of the lungs; the increase by transfusion would but supply the materials for the pulmonary function.

*Q.* How does blood-letting act in inflammation of the lungs?

*A.* It acts by decreasing the quantity of blood which enters the organ; it diminishes the irritation of the vital forces which draws blood to the part and retains it. You well know that as irritation in a part is removed, the flow of blood diminishes.

*Q.* How does Beclard say the erectile tissue is formed?

*A.* He says it is composed of small arteries and veins, which intercommunicate as the capillary net-work does; and that there is a much greater development of the branches of the veins in the erectile tissue.



## EXHALENT SYSTEM.

*Q.* In what respects do exhalation and secretion agree?

*A.* In this, that both operations separate fluids different from the blood.

*Q.* In what respects do exhalation and secretion differ?

*A.* Chiefly in these particulars; that in the secreting organs there is an intermediate organ between the arteries and excretories, but there is none between the arterial terminations and the exhalents; that the secreted fluids are much more complicated than those which are exhaled; that exhalation takes place from an infinite number of distinct vessels, while the secreted fluids are directed to one or two tubes which convey them from the organ; that the secreted fluids are thrown off, becoming excrementitious, while the exhaled are most of them recrementitious; that numerous surfaces receive the exhaled matters, while the secreted are principally poured out on the mucous and cutaneous.

*Q.* Name some of the exhaled fluids.

*A.* There is the fat, and the serum, the synovia, the marrow.

*Q.* Now indicate some of the secretions.

*A.* You have the bile, urine, semen, pancreatic fluid, saliva, and others.

*Q.* What do you mean by exhalents?

*A.* They are small tubes or vessels arising from the capillary system, continuous with the arteries which bring them the materials for exhalation.

*General Arrangement of the Exhalents.*

*Q.* How are the exhalents divided?

*A.* Into three orders; those terminating on the outlets at the cutaneous and mucous surfaces, those which terminate on the internal organs, and those which convey the nutritive matter.

*Properties and Functions of the Exhalent System.*

*Q.* What are the properties of the exhalents?

*A.* Destitute of animal sensibility and animal contractility, their vital properties on which their functions depend are organic sensibility and insensible organic contractility.

*Q.* How is it that the exhalents of the different organs and surfaces pour out uniformly their appropriate fluids?

*A.* As the blood whence the exhaled fluids are derived, is in all organs the same, the power by which each organ separates its own fluid must result from peculiarity in the organic sensibility and contractility of these organs.

*Q.* Will you be more explicit on this subject?

*A.* It is either because the blood whence the exhalation proceeds is specifically distinct in the various surfaces, or the vital properties of the solids so differ as to produce the various exhalations. There is nothing concerned in the process but the blood and the solids which it stimulates.

*Q.* To what has exhalation been ascribed?

*A.* To a distillation through the coats of the arteries.

*Q.* How do you account for morbid or altered exhalations?

*A.* They depend on deranged organic sensibility, a change of relation between it and the blood.

*Q.* How is this organic sensibility deranged in the exhalents?

*A.* By the direct impressiōn of irritation, by sympathetic power, and in an unknown way.

*Q.* Give an instance of direct irritation of the exhalents.

*A.* You see it in the action of cold on the skin.

*Q.* Give an example of sympathetic impression on the exhalents.

*A.* An instance is found in the sweating which is induced by pain in the fibrous and muscular tissues.

*Q.* What exhalents are exclusively exposed to direct stimulation?

*A.* The exhalents of the skin and mucous membranes; besides this exposure to direct irritation, they are liable to the sympathetic derangements; and hence they are more frequently diseased than any other exhalents.

*Q.* Are all the exhalations simultaneously diminished or increased?

*A.* In fever they are all diminished. As a general rule, when one exhalation is increased another is diminished; as you see the hectic sweats in phthisis diminished by the dropsical infiltrations which come on in the last stages of the disease.

*Q.* How are morbid exhalations divided?

*A.* Into those attended with exalted vital forces, and those where these forces are diminished.

*Q.* What are preternatural exhalations?

*A.* Any discharges from the exhalents which differ from the natural.



*Q.* What exhalents most frequently pour out blood?

*A.* The mucous.

*Q.* What are the evidences that these mucous hæmorrhages are exhalations?

*A.* The mucous surfaces, though minutely examined after death, show no ruptured points; pressure on the uterus after death during menstruation exhibits an issue of bloody drops, but no rupture can be seen; the womb would exhibit a surface of cicatrices, if hæmorrhages proceeded from erosion; the sudden translation of hæmorrhages from one part to another, under sympathetic laws, tend to confirm the doctrine of exhalation rather than rupture; the causes of hæmorrhage from rupture are so different from those of spontaneous hæmorrhage; and lastly, these accidental hæmorrhages are not under the laws of sympathy, as the spontaneous are.

*Q.* What is the anatomical distinction between hæmorrhage and inflammation?

*A.* In inflammation the blood accumulates in the capillaries; in hæmorrhage the blood passes out from the arteries by the exhalents.

*Q.* Is it not probable that the irritation is differently located in the two diseases?

*A.* Perhaps it is seated in different vessels in hæmorrhage and inflammation.

*Q.* What proof have you that in active hæmorrhage the organic sensibility is altered?

*A.* The previous symptoms of heat, pain, itching, show that it is altered.

*Q.* In passive hæmorrhages how are the vital forces of the exhalents affected?

*A.* The organic sensibility and insensible organic contractility are diminished.

*Q.* What locality has hæmorrhage in organic disease?

*A.* Proximity to the mucous surface governs it; for instance, when the liver is diseased, the hæmorrhage will be from the mucous expansion of the stomach or intestines; when the heart is diseased, the bleeding will be from the pulmonary mucous tissue.

*Q.* Does the whole mucous tissue ever pour out blood at one time?

*A.* Never.

*Q.* Why are the mucous tissues so liable to hæmorrhage?

*A.* The short course of the blood in the capillaries to the mucous surfaces, and the general fulness of these tissues with blood.

*Q.* Which mucous surfaces are least liable to hæmorrhage?

*A.* Those lining the sinuses of the face and ear.

*Q.* Is plethora necessary to active hæmorrhage?

*A.* It is not; for a mere local increase or alteration of the vital forces will produce it. Hence there may be active hæmorrhage without plethora.

*Q.* How will you account for the varieties in the quantity of the menstrual discharge?

*A.* It varies as the vital forces of each uterus do.

*Q.* What essential difference must be observed in the treatment of capillary and exhalent hæmorrhage, and arterial?

*A.* In the hæmorrhage from the two first named sources, medicines which act on the organic sensibility of the part

are successful; but in the case of the bleeding artery they have no effect.

*Q.* How do you know that blood found in serous cavities is exhaled?

*A.* Because, after the most critical examination, no erosion could be ascertained.

*Q.* What serous cavities are least liable to these bloody exhalations?

*A.* The tunica vaginalis testis, and the tunica arachnoides.

*Q.* Are the bloody exhalations in serous cavities always from active hæmorrhage?

*A.* The exhalation of blood in these cavities is sometimes passive.

*Q.* Does the water in anasarca being reddish, imply active hæmorrhage or febrile dropsy?

*A.* It does not, for the fluid of dropsy is often of this reddish hue in passive cases.

*Q.* Are preternatural exhalations uniform?

*A.* They vary very much, as you may see in the various aspects of fluids in the different serous cavities.

*Q.* Why are not secretions exhaled as well as fat, serum, and other fluids?

*A.* Because the glandular apparatus is different from the exhalent.

*Q.* How does Mascagni suppose exhalations to be made?

*A.* By lateral pores in the vessels.



## ABSORBENT SYSTEM.

*Q.* What do you mean by the absorbent system?

*A.* It is a series of vessels, uniting in trunks, and enlarging occasionally, so as to form what are improperly termed glands.

### *Of the Absorbent Vessels.*

*Q.* Where do the absorbents arise?

*A.* They take their origin from every part of the body.

*Q.* Where do the trunks of this system of vessels terminate?

*A.* In the vena cava of the black blood system.

*Q.* Why are the enlargements of these vessels improperly called glands?

*A.* Because they do not pour out fluids by excretories arising from them.

*Q.* What is the general division of the absorbents?

*A.* Into the exterior and interior absorbents.

*Q.* What is the difference between the exterior and interior absorbents?

*A.* The external absorbents do not take up the fluids exhaled; those on the skin do not absorb the perspiration; nor do the mucous absorbents take up the pulmonary or gastric exhalations. They absorb foreign matters. The internal absorbents are constantly engaged in taking up what is exhaled.

*Q.* What is it that renders absorption of the solids practicable for such delicate vessels as the absorbents?

*A.* Solids, like fluids, are composed of minute particles, and vessels remove a particle of the one as they do of the other.

*Q.* In what system do the absorbents arise?

*A.* Of course they arise in the capillary tissue.

*Q.* How are the absorbents of the extremities divided?

*A.* Into the superficial and the deep-seated.

*Q.* How are the absorbents of the trunk divided?

*A.* Into the superficial and deep-seated of the *parietes* of the trunk of the body; and into the superficial and deep-seated of the *viscera*.

*Q.* Where have they not yet been found?

*A.* In the cavity of the cranium.

*Q.* In form how do the absorbents differ from the veins?

*A.* The absorbents do not enlarge in their course as the veins do; they compensate for their small size by the number of tubes.

*Q.* How can you have the best natural view of the absorbents?

*A.* By examining the concave surface of the liver, very speedily after opening the abdomen of the dog or other large animal.

*Q.* In what disease are they often remarkably enlarged?

*A.* In dropsy.

*Q.* What constitutes the difficulty in deciding on the capacity of the absorbents?

*A.* The same as in the case of the veins; both veins and absorbents are so extensible and contractile, as to be ever varying in size.

*Q.* Do they resemble the veins in any other respects?

*A.* They resemble them in their frequent anastomoses; in the aids the motion of their fluids require and receive from adjacent pressure, and in the influence of gravity on their fluids.

*Q.* Why are the legs more swelled, in dropsy, in the evening than in the morning?

*A.* Because of the influence of gravity on the absorbents debilitated by disease.

*Q.* Why does the arm swell more from pressure of the head of the humerus in the axilla in certain cases, than when extensive pressure is made on the upper part of the arm?

*A.* Because in the axilla a greater number of absorbents are compressed, and swelling of the limb below them rather depends on this circumstance than on the extent of the surface compressed.

*Q.* What visceral enlargement has the greatest influence in tumefying the lower extremities?

*A.* That of the uterus, because in its enlargement it compresses the greatest number of absorbents.

*Q.* Have the other abdominal viscera the power of producing infiltration by this pressure?

*A.* They have not; and when this infiltration arises in the diseases of other viscera, it is not from pressure but from an increase in the vital forces of the exhalents.

*Q.* What has heretofore been the ascribed cause of dropsy from these visceral enlargements?

*A.* It was ascribed to an obstruction of the venous blood causing effusion; but it is really owing to an obstruction to the absorbents.

*Q.* What is the structure of the absorbents?



*A.* A dense cellular coat, and a lining membrane continuous with that of the veins. There is no fleshy fibre observable in the absorbents.

*Q.* What are the peculiarities of this internal lining membrane of the absorbents?

*A.* It is in the dead body bedewed by an unctuous, and in the absorbents of the external surface of the lungs frequently covered with a white matter which resembles plaster.

### *Of the Lymphatic Glands.*

*Q.* What peculiarities attend the situations of the lymphatic glands?

*A.* They are most abundant where cellular texture abounds, and they are more numerous as they approach the common trunks.

*Q.* What is the colour of the glands?

*A.* They are red in childhood, gray in adult life, and yellowish in old age.

*Q.* At what period of life are they most developed?

*A.* They are more fully developed in childhood; they are least so in old age.

*Q.* These glands have a common and a peculiar texture—what are they?

*A.* The common texture is a loose and dense cellular investment; the peculiar texture is a pulpy matter, of greater or less density, resembling the pulp of the nervous ganglions.

*Properties of the Absorbent System.*

Q. What properties of texture do the absorbents and glands possess?

A. Extensibility and contractility.

Q. What vital properties attach to them?

A. But little animal sensibility in health, but considerable in diseases. They have no animal contractility. Obviously, they have organic sensibility and insensible organic contractility.

Q. What remarkable phenomenon attends these two last named properties in the absorbents?

A. The organic sensibility and the insensible organic contractility continue some hours after death in some bodies; or in other words, absorption continues after death.

Q. How does the organic sensibility of the absorbents differ from that of the glands?

A. In the absorbents it is in relation to many fluids; glands admit but one.

Q. What difference appears between the lining membrane of the absorbents and that of the veins?

A. The greater susceptibility of the first to inflammation.

Q. What is a common consequence of inflammation of the lymphatic glands?

A. Scirrhus hardness much more frequently follows inflammation in them than in other structures.

Q. What shows a difference between the vital properties of the absorbents and lymphatic glands?

A. The fact that the glands are so frequently inflamed by matters which do not affect the absorbents.

*Q.* What are the usual causes of inflamed lymphatic glands?

*A.* The absorption of matter, and sympathetic impression.

*Q.* Give instances of sympathetic affection of the glands.

*A.* You see them in axillary or inguinal swelling proceeding from the prick of a thorn, a blister, or any other irritant of that kind.

*Q.* In what way are the lymphatic glands most frequently inflamed?

*A.* They take on inflammation in the progress of organic visceral disease; the glands partaking of the acute, chronic, or specific action, which prevails in the viscus. In mammary cancer the axillary glands are diseased; in scirrhus stomach, or diseased liver, the mesenteric glands are affected, and so forth.

*Q.* How does an enlarged strumous lymphatic gland differ from one enlarged by ordinary causes?

*A.* In the strumous enlargement the structure of the gland is at first affected; in those enlarged by ordinary causes, it is secondarily involved. The scrofulous glands have a whitish substance, which finally destroys the whole gland.

### *Of Absorption.*

*Q.* Why do you suppose the action of the absorbents to depend on vital, and not on capillary power?

*A.* Because fluids are received or rejected according to their relation to the organic sensibility of the absorbents; they have a peculiar organic sensibility.



*Q.* How do medicines act in producing absorption?

*A.* By increasing the organic sensibility of the absorbents; and such are the variations in the degrees to which organic sensibility can be raised, as to account for the absorption of the various fluids.

*Q.* Will these considerations account for the introduction of morbid matter by the lungs and lacteals?

*A.* They will; for if the organic sensibility of the lacteals, or of the pulmonary absorbents be increased, they will take in matters which in their healthy state would be rejected.

*Q.* What circumstances vary the natural type of the sensibility of the absorbents?

*A.* Direct causes, such as frictions to the skin; and sympathetic causes, as when the absorbents are acted on by a distant viscus.

*Q.* What conspicuous difference appears in the channels of the veins and absorbents?

*A.* The fluid in the absorbents has to pass through numerous glands, in each of which is a kind of capillary system; this, while it affects the course of the lymph, may also when the glands are diseased, change the quality of the lymph. The veins have no such glands to pass through in their progress to the heart.

*Q.* What three phenomena always accompany each other in the organs?

*A.* Great development, attended by activity of function, these giving rise to disposition to disease.

*Q.* What reference has the answer to the last question to the absorbent glands?

*A.* In childhood there is great development of the ab-

sorbent system; at that period of life, the functions of this system, whatever they may be, are in great activity, and there is great disposition to disease at the same time.

*Q.* What period of life limits the predominance of the lymphatic glands?

*A.* Puberty.

*Q.* At what ages do external absorption and nutritive absorption predominate?

*A.* In childhood and youth the external absorbents are most active; in advanced life the nutritive absorption is greatest.

*Q.* Explain this expression, nutritive absorption.

*A.* By it is meant that preponderance of absorption in advanced life over nutrition, which leads to the emaciation of age.

*Q.* Why do encysted tumours increase so regularly, and in some cases so rapidly?

*A.* Because absorption in them is feeble compared to exhalation.

*Q.* What, according to Beclard, is the actual structure of a gland?

*A.* There are vessels going to and from the gland; they communicate as the veins and arteries do; and there are little cavities or sacs somewhat resembling the cells of the erectile textures.

*Q.* Is it certain that, as Bichat thinks, the absorbents do not possess *sensible* organic contractility?

*A.* German physiologists have ascertained that certain irritants occasion a contraction of the thoracic duct; and as this does not result from the horny hardening, it is legitimately ascribed to *sensible* organic contractility.



## PATHOLOGY OF THE ABSORBENT SYSTEM.

*Q.* What are the diseases of this system?

*A.* Inflammation, induration, scrofula, ossifications, cancer, lymphatic varix, sympathetic bubo.

*Q.* How should this tissue be divided in considering its diseases?

*A.* There are the diseases of the lymphatic glands, as they are improperly termed, and those of the vessels.

*Q.* At what period of life are these diseases most frequent?

*A.* In childhood; they are infrequent in age.

*Q.* What are the divisions of diseases of this tissue?

*A.* They are idiopathic and symptomatic diseases.

*Q.* Divide the inflammations of the lymphatic glands.

*A.* They are acute and chronic, simple or specific.

*Q.* How is this inflammation excited?

*A.* By a remote irritant, or by absorbing a poison which comes into contact with a gland.

*Q.* Is the absorbent which conveys a poison to a gland necessarily inflamed thereby?

*A.* It is not; the gland may be inflamed alone, or both vessel and gland may be.

*Q.* What glands are most liable to inflammation?

*A.* Those of the axilla and groin.

*Q.* What peculiarity is there in the symptoms of inflamed glands?

*A.* The pain is less acute, and the progress slower than in phlegmon.

*Q.* Where is the matter formed in a lymphatic gland?



*A.* In the centre of it. The gland is not disorganized, but enlarged and inflamed.

*Q.* What absorbent vessels are principally inflamed?

*A.* Those of the inferior extremities.

*Q.* Where is the scrofulous affection of this tissue most common?

*A.* In the abdomen, thorax, and neck.

*Q.* What occasions marasmus in tabes mesenterica?

*A.* The gradual diminution in the absorption of the chyle, owing to progressive destruction of the function and organization of the mesenteric glands.

*Q.* How is the dyspnœa from tabes mesenterica produced?

*A.* By co-existent though consecutive disease in the lymphatics of the lungs.

*Q.* What are the progressive stages in the scrofulous disease of a lymphatic gland?

*A.* The gland is first in chronic inflammation; next it is in part steatomatous, then it is completely steatomatous, and lastly it degenerates into the formation of bad pus and ichorous fluid. In adopting this view, ascertain whether the scrofulous degeneration is altogether steatomatous.

*Q.* Why are not scrofulous swellings of the neck fatal?

*A.* Because their progress is bounded by parts not disposed to take on disease, or not vital if they do.

## OF SYSTEMS PECULIAR TO CERTAIN APPARATUS.

*Q.* What systems have heretofore been considered?

*A.* Such as may be termed primitive; such as are common to all parts; those which form the nutritive parenchyma.

*Q.* What tissues remain to be considered?

*A.* Those which belong to special purposes in the animal economy.

*Q.* Explain this more particularly?

*A.* While the above systems are general, there are certain others which are not so, but are appropriated to certain functions separately or conjointly. You observe that the bones, muscles of animal life, the cartilages and fibrous tissue appertain to locomotion; while the serous, mucous, and organic muscular systems are particularly directed to digestion, respiration, and circulation. So it is likewise with the glandular tissue which belongs to secretion; other examples might be adduced.

*Q.* What further difference is observed?

*A.* The primitive are universally found and are continuous, as the cellular tissue; the special tissues are insulated, and separated from each other by the intervention of organs, as the bones.

## OSSEOUS SYSTEM.

Q. What is this system?

A. A tissue characterized by hardness and resistance, admirably calculated for a base, support and protection of the soft parts.

### *Forms of the Osseous System.*

Q. What are the forms of the bones?

A. They are long, flat and short.

Q. To what purpose in the animal economy are the long bones principally appropriated?

A. To that of locomotion.

Q. Where are the longest bones found?

A. In the superior parts of the upper and lower extremities. The bones diminish in their length, but become more numerous as you approach the fingers and toes?

Q. What is the consequence of this location of the long and short bones?

A. That the superior part of the extremities has the most extensive motion, while the inferior part has the greatest number and variety of limited motions.

Q. What is the general conformation of these long bones?

A. They are larger at the extremities than in the shaft, which last is usually rounded.

Q. What advantages result from these enlarged extremities of the long bones?



*A.* They prevent dislocations, and preserve the symmetry of the limb to which they are attached.

*Q.* What general features are conspicuous in the bodies of the long bones?

*A.* The ridges for the implanting of aponeuroses; and the twist in most of these bones.

*Q.* At what period is the medullary canal formed?

*A.* At the period of ossification; it does not exist at the earliest foetal periods. It is not found while the bone is cartilaginous.

*Q.* How is this canal formed?

*A.* By the absorption of the gelatine in the centre, no more of which is exhaled. Observe the different processes which take place at the same time in the exterior and interior of the bone; for, while the absorbents remove the gelatine and thus form the medullary canal, and the exhalents cease to deposit gelatine, the exhalents on the external surface of the bone are placing a wall of phosphate of lime to give the bone firmness and smoothness.

*Q.* In what bones is the medullary canal found?

*A.* In the humerus, in the radius, in the ulna, in the femur, in the tibia, in the fibula, and in the clavicle.

*Q.* What is the form of the canal?

*A.* It is cylindrical and straight.

*Q.* What are the uses of the medullary canal?

*A.* It gives lodgement and protection to the medullary organ, and renders the bone stronger; for a hollow cylinder will be less apt to break or bend than a full one.

*Q.* What would be the inconveniences of a solid cylinder for the shaft of a bone?

*A.* They would impede the motion of the limbs, if

solid, and of the dimensions of the hollow cylinder; and if smaller and solid, there would not be surface enough for the insertion of muscles and aponeuroses.

*Q.* How is this medullary canal affected in fractures?

*A.* When callus is first formed, gelatine is so deposited as to close the canal; but this gelatine is subsequently absorbed, and the continuity of the canal reinstated.

*Q.* What purposes do the flat bones serve in the system?

*A.* They are especially appropriated to form cavities.

*Q.* Are the cavities usually formed of one or many bones?

*A.* Of many bones; and hence, in part, their solidity, and the limits set to their fractures.

*Q.* Why are fractures of all the bones more infrequent in children than in adults?

*A.* Because ossification being incomplete, the bones yield rather than break.

*Q.* What is the form of the flat bones?

*A.* They have a convex and concave surface. The curve forms in age a bony arch; a mechanism powerful for strength and protection.

*Q.* At what part is a flat bone thinnest?

*A.* It is thinnest in the centre; the circumference being thickest, forms a broader surface for union, and offers points for muscular origin in some bones, as the spine of the ilium.

*Q.* Are there cells in the flat bones?

*A.* There are; they are between the two layers.

*Q.* What purposes in the œconomy are attained by short bones?

*A.* The two great ones of solidity and mobility; hence

these bones are found in the spinal column, and in the hands and feet.

*Q.* How does their number give solidity or strength?

*A.* The bands requisite to unite them are so frequent and strong as to produce these effects.

*Q.* And how does their number give mobility?

*A.* Their individual motions tend to communicate general mobility.

*Q.* What is their general appearance?

*A.* They are very rough, with cavities and eminences for their articulations, for their muscles and ligaments.

*Q.* What is their internal structure?

*A.* They are almost entirely cellular.

*Q.* What influence has this structure on the diseases of these short bones?

*A.* It renders them liable to frequent caries.

*Q.* What is the general name of the bony eminences?

*A.* They are usually denominated apophyses.

*Q.* What do you mean by epiphyses?

*A.* They are points of bony eminence, which are not entirely united to the principal bone by calcareous union; epiphyses are united to the bone by cartilage.

*Q.* How are the bony eminences divided?

*A.* Into four classes; those of articulation, of insertion, of reflection, and of impression.

*Q.* What are attached to the eminences of insertion?

*A.* The fibrous organs exclusively, such as ligaments, tendons, &c.

*Q.* Where do you find these eminences of insertion most conspicuous?

*A.* In strong men, in carnivorous animals. The size of these protuberances indicates the strength of the animal.



Q. What do you mean by an eminence of reflection?

A. One under which a tendon passes when it deviates from its original course.

Q. What are the external cavities of bones and their uses.

A. They give increased space for aponeurotic and ligamentous insertions; they receive, lodge, and protect organs or portions of organs; they form grooves for the passage of tendons; they transmit nerves and blood-vessels through the bones, and those vessels which nourish the bones.

Q. Are these grooves for the tendons, for example, those at the ends of the long bones, formed by the friction and pressure of the tendons, or are they of natural, primitive osseous development?

A. If formed by the friction of tendons, they ought to be deep or superficial in proportion to the action of the muscles and the age of the subject; they should not be found in the foetal cartilages; they would be very slight in infancy; on the contrary, they are fully developed at all periods of life, and are therefore original.

Q. How are the cavities or foramina of nutrition in the bones divided?

A. There is that in the body of the bone which conveys nutrition to the medullary canal; there are those which nourish the cellular structure at the ends of the bones; and there is a third set, viz. those which supply the compact texture.

### *Of the Organization of the Osseous Texture.*

Q. What is the texture peculiar to the osseous system?

*A.* It is fibrous. The fibres being differently arranged so as to constitute the loose or cellular, and the compact, bony structure.

*Q.* How is the cellular bony structure formed?

*A.* Unknown in the first periods of ossification, the cells appear in consequence of the absorption of the solid mass of cartilage, and in its place are deposited by exhalation transverse bony fibres, which, by interlacing in every direction, and no more gelatine being thrown out, leave the cavities which are the cells of bones.

*Q.* Can you present a clear illustration of your last answer?

*A.* The os ethmoides is at one period a solid cartilage, but under the laws and in the process of ossification, the interlacing bony fibres are exhaled, and the cartilage absorbed leaving cells.

*Q.* Do the cells communicate with each other?

*A.* Conclusive experiments prove that the cells throughout the interior of a bone communicate universally.

*Q.* How does the compact texture of bones differ from the cellular texture?

*A.* The fibres of the compact texture are in dense juxtaposition.

*Q.* How do these compact fibres run in the long, flat, and short bones?

*A.* These bony fibres are longitudinal in the long, radiated in the flat, and run in every direction in the short bones.

*Q.* Do the fibres of this texture, in the apophyses, pursue the same direction as in the main bone?

*A.* They do not; in some apophyses they are longitudinal, in others the course is entirely irregular.

*Q.* Are the bones lamellated in their compact structure?

*A.* They are not. If they exfoliate in scales, it is by an abnormal process, not by the separation of the natural structure; again, exfoliation does not always assume the form of scales or layers, for it sometimes takes place in a direction differing from the course of the supposed layers. The structure is one of condensed fibres.

*Q.* What is Beclard's opinion as to the laminated structure of the bones in general?

*A.* He thinks, that from a general view of experiments, that the structure is laminated, connected with fibres, and with small areolated spaces abounding between laminated fibrous structure.

*Q.* How does a bone become affected with rachitis?

*A.* In some degree by the absorption of the phosphate of lime, perhaps too by a diminished exhalation of it; but this diseased state arises principally from a separation of the osseous fibres from each other, by which a cellular instead of a compact bony texture is formed.

*Q.* What is the usual general arrangement of the spongy and compact texture of the bones?

*A.* The compact texture is the exterior, and the cellular the interior part of the bone.

*Q.* Is there no exception to this rule?

*A.* It is inverted in the case of the spongy bones of the nose.

*Q.* Where is the compact texture of the long bones greatest?

*A.* It is greatest in the middle of the bones.

*Q.* And why is it so?

*A.* That it may give solidity to the bones, and enable



them to resist fractures where they are most exposed to them, and that the size of the bone may be reduced, where such reduction is necessary, without injuring its strength.

*Q.* What is the reticular texture of the bone?

*A.* It is a delicate modification of the cellular texture; and it supports the medullary texture of the bones, and offers points of insertion to the membrane of the medulla.

*Q.* How is a light cellular structure at the ends of the bones advantageous?

*A.* The weight of heavy compact structure at the ends of the levers would be difficult to raise, and thereby impede locomotion.

*Q.* Where are the compact and cellular structures found in the flat bones?

*A.* The compact is in the centre, the cellular is at the periphery.

*Q.* What texture prevails in the short bones?

*A.* The cellular structure principally forms them.

*Q.* Of what do the osseous protuberances consist?

*A.* Principally of compact texture.

*Q.* What are the elements which enter into the composition of the osseous texture?

*A.* A calcareous and gelatinous substance.

*Q.* What is this calcareous substance?

*A.* It is the phosphate of lime; and there are a few other unimportant saline matters that enter into the composition of bone.

*Q.* Is the proportion of the constituent parts of bony structure uniform?

*A.* It is not; on the contrary, it varies much. The teeth have much more earthy substance than other bones.

*Q.* Is the softer substance pure cartilage or gelatine?

*A.* That it is fibrous texture cannot be doubted; it is neither exclusively cartilage nor gelatine; the phosphate of lime is deposited between these fibrous spaces, and thus constitutes bone.

*Q.* What part of the bone possesses vitality and affords nutriment?

*A.* The gelatinous substance.

*Q.* What vessels deposite the calcareous bony matter?

*A.* The red blood-vessels.

*Q.* Does a different set of vessels deposite the gelatine?

*A.* It is poured out by white vessels.

*Q.* What is the aspect of osseous vascularity, at different periods of life?

*A.* The vascularity of the bones diminishes with age, and with this diminution of vascularity is a corresponding declension in the readiness to form callus.

### *Of the Properties of the Osseous System.*

*Q.* What are the physical properties?

*A.* The bones are extremely solid, and hard; in the bones of young persons there is slight elasticity, which is entirely lost in advanced life.

*Q.* Do the bones possess or exhibit textural properties?

*A.* Bichat supposes that in spina ventosa extensibility of bony texture is manifested; and this is also exhibited in the distention of the antrum with polypus. On the contrary, the alveoli contract when the teeth are removed; the orbit contracts when a cancerous eye has been removed.

*Q.* What are the vital properties of the bones?

*A.* They have no animal sensibility in health, but manifest it in very great degree in disease. They have no animal contractility; they are destitute of sensible organic contractility. One would scarcely admit an insensible organic contractility in the firm structure of bones.

*Q.* On what does the vitality of the osseous tissue depend?

*A.* It is dependant on organic sensibility and insensible organic contractility. These two properties they certainly possess.

*Q.* What influence has the obscurity of the osseous vital properties on the diseases of that texture?

*A.* The vital properties of the bones are slow in the production and prosecution of diseased action.

*Q.* There are two sets of symptoms in all acute diseases, what are they?

*A.* Those that relate to the affected organ, and those that sympathetically connect this organ with the vital forces of other parts.

*Q.* Are the bones readily acted on by the vital forces of other organs?

*A.* They are not; they remain unaffected. Their vitality does not admit of the sudden alterations in acute diseases.

*Q.* In what part of the osseous tissue are the vital properties seated?

*A.* In the cartilaginous or gelatinous substance.

*Q.* What produces a morbid brittleness in the bones?

*A.* A deposition of phosphate of lime, in quantity disproportioned to the gelatine.



*Articulations of the Osseous System.*

*Q.* How are the general classes of articulations divided?

*A.* Into those with, and those without mobility.

*Q.* To what purposes are the articulations with mobility directed?

*A.* They belong to the bones of locomotion.

*Q.* Where are those without mobility found?

*A.* In the bones whose union forms cavities to defend the important organs.

*Q.* What motions do the articulations with mobility allow?

*A.* There are four motions, viz. of opposition, circumduction, rotation and sliding.

*Q.* What do you understand by the motion of opposition?

*A.* It is simple flexion and extension—abduction and adduction.

*Q.* What is the motion of circumduction?

*A.* Circumduction is a movement in which the bone describes a kind of cone, the apex of which is in the superior articulation, and the base in the inferior. Circumduction comprises all the motions of opposition.

*Q.* How does rotation differ from circumduction?

*A.* In this, that in circumduction the bone has locomotion, in rotation there is none; in rotation the bone turns on its own axis.

*Q.* What is the sliding articulation?

*A.* It is a motion appertaining to all the articulations, and one described by the term.

*Q.* What indicates the disposition to luxation in an articulation?

*A.* The number and freedom of its motions.

*Q.* What articulations afford extension, opposition, circumduction, and rotation?

*A.* The humerus and scapula, the femur and ilium.

*Q.* What advantages arise from the location of these extensive motions at the upper part of the extremity?

*A.* The joints are less exposed to accident and luxation; the powers of motion being located in the superior articulations, the whole limb has extensive motion, thereby making up for the necessarily limited motion of the joints below.

*Q.* What form of articulating surfaces is necessary for these extensive motions?

*A.* That the receiving surface should be concave, and the moveable one convex.

*Q.* What are the principal differences between the motions of the humeral and femoral articulations?

*A.* In the humeral there is much circumduction, but little rotation; in the femoral there is much rotation, but little circumduction. There is pronation and supination for the hand to compensate for the want of rotation in the humeral articulation; while the rotation of the femoral articulation renders pronation and supination unnecessary in the lower extremity.

*Q.* On what principle in the mechanical arrangements of the articulations, does the facility of circumduction depend?

*A.* It depends on the "axis of the bone, and that of the motion being the same," as is seen in the humeral articu-

lation, where there is much circumduction. The circumduction of the femur is impeded by the distance of the axis of motion from that of the bone being the whole length of the neck of the thigh bone.

*Q.* Give examples of articulations in which opposition and circumduction are alone met with.

*A.* In the angle of the jaw is a conspicuous one; you see others in the wrist and radius, in the first phalanges.

*Q.* Mention instances of the motion of *opposition* confined to one direction, without circumduction and rotation.

*A.* The knee, the elbow, second phalanges of the fingers. These articulations are found in the middle joints of limbs.

*Q.* What conformation marks these articulations of *opposition*, without circumduction or rotation?

*A.* Prominences, such as condyles on the articular surfaces; or eminences and cavities fitted for each other; these, with some other arrangements, prevent other motions than those just mentioned. These articulations are remarkable for breadth of surface.

*Q.* Why are luxations of these articulations more dangerous than others?

*A.* Because so many bands and ligaments are torn up in their dislocation.

*Q.* On what side is there the greatest motion in these articulations?

*A.* On that of flexion; hence the strength of the flexor fibres, and also the location of the nerves and vessels for security.

*Q.* Can you give examples of articulation with rotatory motion alone?



*A.* The ulna with the radius rotates only, the atlas with the dentatus; in these, luxation is very difficult.

*Q.* Where do you find the articulations with sliding motion alone?

*A.* They are very numerous; the vertebræ on each other; the carpus and metacarpus; the tarsus and metatarsus; the sternal end of the ribs.

*Q.* What do you mean by the immoveable articulations?

*A.* Those where surfaces of juxtaposition are so wedged in as to retain the part; as the malar bone confined between several other bones of the face. There is an order of indented articulations immoveable as by suture; there is another with implanted surfaces, as the teeth.

*Q.* What effect has age on the articulation by suture?

*A.* It obliterates the suture by bony union.

*Q.* Why do not the teeth unite to their sockets by age?

*A.* Because there is an intervening mucous membrane not disposed to ossify. The teeth constitute the only order with implanted surfaces.

*Q.* What preserves the union of the immoveable articulations?

*A.* Cartilages and membranes. The cartilages are most conspicuous in infancy.

*Q.* How are the moveable articulations united?

*A.* By ligaments and muscles; these bonds of union are freer in youth than age.

*Q.* How does the office of cartilage differ in the immoveable and moveable articulations?

*A.* It is a bond of union in the first, and facilitates motion in the second.

*Development of the Osseous System.*

Q. At what period is ossification complete?

A. From the eighteenth to the twentieth years.

Q. What are the states of the bones during growth?

A. There are the remarkable states of the osseous texture; viz. the mucous, the cartilaginous, and the osseous.

Q. At what period do you see the mucous state?

A. It appears in the earliest periods of the development of the embryo, and continues till the vessels commence conveying gelatine. The cartilaginous state succeeds this, and finally the deposition of phosphate of lime takes place.

Q. What is the first indication of calcareous deposition?

A. The appearance of red blood in the cartilaginous bed of the bone. This blood enters vessels which formerly conveyed gelatine. There is always in the process of earthy exhalation a red layer which is vascular, between the cartilage and that portion of the bone where calcareous deposition has taken place.

Q. Why do the vessels which once conveyed white fluids, afterwards admit red blood?

A. Such is the fact in the deposition of calcareous matter in ossification, and it proceeds from a change in the relation of the vital forces of the vessels to the fluids, receiving at one time white, at another red fluids.

Q. At what period does the osseous state commence?

A. It appears first in the clavicle, the ribs, &c. about the end of the first month.

Q. Where do the long bones increase in length?

A. Only at the extremities, not in the middle. An ac-

curate experiment, made by Mr. Hunter, proves this; he bored holes in the middle of a long bone, and although the bones had grown considerably longer, the holes were no farther apart.

*Q.* In what way does a bone grow after the twentieth year?

*A.* It grows in thickness. Observe the difference in a thigh bone eighteen years old and one of forty.

*Q.* What evidence is there that exhalation and absorption go on in the bones?

*A.* The experiment of feeding with madder makes this manifest; this colouring substance is alternately deposited and removed. It is never coloured when gelatine alone is in the bone; now this proves that the calcareous exhalation is the vehicle of it.

*Q.* Can you, by giving gelatine or phosphate of lime, supply a defect of these constituents in the bony system?

*A.* No; unless you can bring the organic sensibility of the exhalents of the bones in due relation to the blood containing these principles, the vascular system of the bones would reject it.

*Q.* What changes take place in the bones of old persons?

*A.* They become of a grayish colour, and they are heavier in old people, owing to the preponderance of calcareous deposition.

*Q.* Beclard mentions a cause of the brittleness of bones in advanced life, what is it?

*A.* Usually, as the medullary canal enlarges, so does the exterior of the bone; but sometimes, in advanced life, the canal continues to enlarge, at the expense of the thickness of the walls, and hence the bone is more brittle.



*Q.* What organs are most prone to take on the process of ossification in advanced life?

*A.* Those, the nutritive matter of which, is habitually gelatine, as cartilage. The exception to this is the arterial ossifications which so commonly take place.

*Q.* How many periods are there in the development of callus?

*A.* There are three; the formation of cellular granulations, the change of these granulations to the cartilaginous state, and the deposition of bone or calcareous substance.

*Q.* What prevents the union of broken bones?

*A.* Such frequent motion of the ends of the broken bones, as prevents the union of the parenchymas of nutrition.

*Q.* Why is union more difficult in a compound fracture?

*A.* Because the process of suppuration wastes the nutritive restorative matter.

*Q.* Of what are the teeth composed?

*A.* Of enamel, of ordinary bone, and a cavity containing a spongy substance, with which we are unacquainted.

*Q.* What experiment proves the difference between the enamel and the ordinary bony substance of the teeth?

*A.* Diluted nitric acid, while it softens both portions, whitens the enamel, and renders the osseous portion yellow.

*Q.* Is the enamel an organized substance?

*A.* While it has sensibility to external impression, it does not take on diseased action; it is neither absorbed

nor re-deposited; on the whole, the question is by no means a settled one.

*Q.* What vital property is conspicuous in the membrane of the teeth?

*A.* Animal sensibility to a most acute degree.

*Q.* What sympathies are excited by diseases of the teeth?

*A.* Those of animal sensibility, and of animal contractility. The first is exemplified in the pains of the teeth; the second in the convulsions produced by teething.

*Q.* Present examples of the organic sympathies.

*A.* Those of sensible organic contractility, such as vomiting, purging, and increased frequency of the heart's action. You see those of organic sensibility and of insensible organic contractility in the profuse salivary discharges from dentition, and other tooth affections; you see them likewise in the swellings of the face.

*Q.* How do the teeth usually sympathize with each other?

*A.* They sympathize in the frequent affections of corresponding teeth, on the opposite sides of the face.

*Q.* To what tissue does the membrane lining the tooth belong?

*A.* It is serous; as evidenced by its appearance, by its having the double night-cap fold, and by the fluid exhaled from it.

*Q.* How is formation of the bony part of the tooth conducted?

*A.* In layers, as it were, from without inward. This is done for the protection of the outer part of the tooth, as that part is first exposed to the contact of foreign bodies.

*Q.* How do you account for double rows of teeth?

*A.* The temporary set are not removed; the permanent take another direction, usually an internal one, appearing as an inner row of teeth.

*Q.* Do the sesamoid bones lie in the direction of the extension or flexion of a joint?

*A.* In all cases in the flexures of the joints, except in the instance of the patella.

*Q.* What is remarkable in the structure of these bones?

*A.* Their fibro-cartilaginous, and fibro-osseous state.

*Q.* Where are they most numerous and conspicuous?

*A.* In the lower extremities; and they are not seen in any part of the bones of the trunk.

*Q.* Where are they exclusively developed?

*A.* In the fibrous organization, as in the tendons or ligaments.

*Q.* Do you mean to say that in their most complete state of ossification, the sesamoid bones are partly fibrous?

*A.* They are; for the tendinous fibres on the upper and lower side of these bones so penetrate its osseous substance, as to be continuous.

*Q.* At what age are they most numerous?

*A.* They are found in greatest number in advanced life.

*Q.* In their union after fracture, how do they differ from other bones?

*A.* They differ in the interposition of a kind of fibro-cartilaginous substance, or, as it has been termed, ligament.

*Q.* In what disease have they been seen remarkably developed?

*A.* In gout.



## OF THE MEDULLARY SYSTEM OF THE BONES.

*Q.* Is there a membrane, or what may be termed an internal periosteum, in the osseous cells.

*A.* Bichat thinks not; but supposes the medulla to be exhaled by a vascular net-work.

*Q.* What part of the osseous medullary system possesses animal sensibility?

*A.* That vital property is found only in the middle of the long bones. The same part of the system possesses extensibility and contractility of texture.

*Q.* Where are the pains usually ascribed to the bones themselves, really seated?

*A.* In the medullary texture in the middle of the long bones.

*Q.* How is the medullary system divided?

*A.* There is the medullary system of the ends of the long bones; that of the short and flat; and that of the middle of the long bones.

*Q.* In what interesting particular does the medullary system of the middle of the long bones differ from the others?

*A.* In this, that the vital forces of that system are much more active than in those of the short and flat bones, or even in the ends of the long bones.

*Q.* Is the marrow altered in diseases?

*A.* In some chronic affections it becomes mucilaginous or gelatinous, resembling in many respects foetal marrow in which there is no fat.

*Q.* What do you mean by internal necrosis?

*A.* The destruction of the medullary substance of the

bone, in which case the periosteum assumes the position of nutritive parenchyma in which osseous matter is deposited.

*Q.* Is there in reality any marrow in the fœtus?

*A.* Beclard says there cannot be, because there is no medullary membrane.

*Q.* Have the medullary membrane, or the marrow any agency in producing the synovia?

*A.* They have not: for you may destroy the medullary membrane, and still the formation of synovia continue uninterrupted; again, the marrow is in greatest abundance in those parts of the bone most remote from the synovia: lastly, in children, where there is no marrow, synovia abounds.

*Q.* What is spina ventosa?

*A.* Beclard says it is a true cancer of the medullary membrane.

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#### PATHOLOGY OF THE OSSEOUS TISSUE.

*Q.* What are the diseases of the osseous tissue?

*A.* Inflammation, caries, necrosis, exostosis, osteo-sarcoma, fragility, and rachitis.

*Q.* What gives peculiar aspect to the diseases of the bones?

*A.* The feebleness in their vital forces.

*Q.* Give an example of healthy osseous inflammation?

*A.* You have it in the process of reuniting a fractured bone.

*Q.* What is caries?

*A.* It is a chronic inflammation of the bones.

*Q.* How does necrosis differ from caries?

*A.* In necrosis the bone is dead, in caries it is in disease.

*Q.* What bones are most liable to caries?

*A.* The spongy bones.

*Q.* How many forms are there of exostosis?

*A.* There is one form in which the enlarged bone is perfectly hard, another in which the exostosis is lamellated, and a third in which there is a mixture of fleshy granulations sprouting from the bony disease.

*Q.* What is remarkable of the hard exostosis?

*A.* That the affection of the soft parts bears no proportion to the extent of the ossification.

*Q.* What bones are most liable to exostosis?

*A.* The cranium and tibia. You often see them on the inside of the head and in the pelvis.

*Q.* Is there resolution or suppuration in exostosis?

*A.* In the hard and lamellated there are neither; but the carneous exostosis accompanies caries, and this is vascular, and there is the termination of the inflammation in suppuration.

*Q.* To what is the fragile bone or brittleness owing?

*A.* To a deficiency of gelatine.

*Q.* What is the pathology of rickets?

*A.* It is a deficiency of calcareous deposition.

*Q.* How is osseous malformation divided?

*A.* Into congenital and accidental.



*Of the Medullary System.*

Q. What is the disease of this tissue?

A. That which is usually termed spina ventosa.

Q. What is spina ventosa?

A. It is a "tumour arising from the development of the bone and increase of its fleshy granulations."

Q. Where is spina ventosa never known?

A. It is never found in the short flat bones.

## CARTILAGINOUS SYSTEM.

Q. How is this divided?

A. Into the cartilaginous and fibro-cartilaginous tissues.

Q. What do you mean by cartilage?

A. It is a substance characterized by hardness, whiteness, elasticity, apparently but not actually inorganic.

### *Forms of the Cartilaginous System.*

Q. What are the three classes of cartilages?

A. Those at the ends of the moveable bones, those at the union of the immoveable bones, those on the parietes of cavities, as the ribs and nose.

Q. What utility results from cartilages at the moveable joints?

A. By the properties of suppleness, elasticity, and yielding, they increase the facility and extent of the motions of the joints, while they break by yielding a little, the violence of the shocks the limbs experience.

Q. Is the nutritive parenchyma of the bone continued into the cartilage?

A. No; they are different, or rather distinct.

Q. Why are the cartilages at the ends of the moveable joints more polished and shining than those elsewhere?

A. The extension of the synovial membrane over those joints communicates that shining appearance.

Q. Do you recollect any instances of cartilages in the immoveable articulations?

*A.* Those in the sutures of the head, and those in the bones of the face.

*Q.* In what respect do the cartilages in the moveable and immoveable joints differ?

*A.* In the tendency of the cartilages of the immoveable joints to ossification, particularly those of the sutures of the head.

*Organization of the Cartilaginous System.*

*Q.* What is the peculiar organization of cartilage?

*A.* It is an intensely dense interlacing of fibres, longitudinal and transverse.

*Q.* Is cartilage disposed to putrescency?

*A.* It resists putrefaction longer than any part, except bones.

*Q.* What change takes place in disease?

*A.* It becomes in some instances, as in hip disease, soft, lardaceous, and vascular. Sometimes it is even osseous, and then medullary cavities are formed and fluid deposited.

*Q.* Bichat mentions another remarkable change of the cartilaginous tissue in disease, what is it?

*A.* In two instances he saw the cartilages of the hip and thigh bones converted into a substance like ivory.

*Q.* What is the *common* organization of cartilage?

*A.* Cellular substance, and in health white fluids, exhalents and absorbents. In disease red fluids are conveyed; in jaundice the cartilages become very yellow. No nerves have been found in cartilages.

*Q.* What proves the existence of cellular texture in cartilage?



*A.* The granulations in wounds of this tissue, besides other evidences, particularly the spongy appearances in diseased cartilage.

*Properties of the Cartilaginous System.*

*Q.* What physical property is most eminently possessed by cartilage?

*A.* Elasticity, and this is greatest in adults.

*Q.* Where are cartilages placed, and what general principles govern their location?

*A.* They are placed where a peculiar union of physical properties as well as vital forces are necessary to the functions of parts.

*Q.* What elementary constituent contributes mainly to the elasticity of parts of the body?

*A.* Perhaps it is more owing to the proportion of gelatine than to any thing else.

*Q.* Are the properties of texture much developed in cartilage?

*A.* Extensibility and contractility are scarcely observable in cartilage.

*Q.* What vital properties belong to cartilage?

*A.* The functions of cartilage imply insensible organic contractility and organic sensibility. Animal sensibility is developed only in their diseases. Animal contractility is foreign from them. Sympathies, either active or passive, are inoperative with cartilages.

*Q.* What then is the general character of the vital properties of cartilage?

*A.* It is that they are slow in operation, and obscure in existence; and consequently their diseases are chronic.

*Q.* What important consideration does the general character of the vital forces of various parts inculcate on the pathologist?

*A.* That these forces are exceedingly various in different tissues. Active in some, their diseases are acute and rapid, and their restoration speedy. Slow in others, their diseases are chronic, and their reunion very tardy. And again, that acute and chronic inflammation are relative, not arbitrary terms; governed in their application by the activity of the vital forces of the part.

*Development of the Cartilaginous System.*

*Q.* What constitutes the mucous bed of the osseous and cartilaginous systems in the fœtus?

*A.* The cellular and vascular parenchyma; this is afterwards penetrated by the peculiar saline and gelatinous substances, which form the bone and cartilage.

*Q.* What effect has age on the deposition of gelatine?

*A.* It diminishes as we advance in life; young animals yield the most jelly.

*Q.* What appearances take place in macerating the cartilages of young animals in water?

*A.* They become of a reddish colour.

*Q.* It has been said that the motions of the cartilages in the moveable articulations prevents their ossifications; may not another physiological reason be given for this?

*A.* In the moveable articulations the organic sensibility of the cartilage not being in relation to the red blood and calcareous substance, they are neither conveyed to the cartilage nor deposited in it; hence ossification does not take place.

*Q.* What change is manifested in the cartilages at advanced periods of life?

*A.* They become ossified in many cases.

*Q.* What does the early tendency of the cartilages of the cavities to ossification often induce?

*A.* More frequent caries of these than of other cartilages.

*Q.* What laryngeal cartilages are most disposed to ossify?

*A.* The arytenoid; in every case of laryngeal phthisis this has appeared on dissection.

*Q.* What different causes give rise to osseous and cartilaginous depositions, where these should not be?

*A.* Age produces the bony deposition; disease gives rise to the cartilaginous formations.

*Q.* Where is preternatural cartilage most frequently found?

*A.* In the spleen and in the lungs.

*Q.* What is the composition of the cartilages?

*A.* Varying in the constituent proportions at different periods of life, they are composed of albumen, mucus, oil, acetic acid, water, phosphate of lime, and other salts.

*Q.* What is the morbid anatomy of the cartilages?

*A.* Swelling and softness in white swelling; they are sometimes absorbed or converted to bone; they ulcerate. When broken they reunite by means of bony bands and bonds.



## FIBROUS SYSTEM.

### *Of the Forms and Divisions of the Fibrous System.*

*Q.* How are the fibrous forms divided?

*A.* Into *membranes* and *fasciæ*.

*Q.* How are the fibrous organs of a *membranous* form arranged?

*A.* Into the orders of fibrous membranes, fibrous capsules, fibrous sheaths, and into aponeuroses.

*Q.* Give some examples of the fibrous membranes.

*A.* You see them in the periosteum, dura mater, the sclerotica, albuginea, the peculiar membrane of several organs, as the spleen and kidney.

*Q.* Where are the fibrous capsules found?

*A.* They are met with around the articulations of the arm and hip, and some others, and wherever found their office is to strengthen the joint.

*Q.* What situations do the fibrous sheaths occupy?

*A.* They bind down the tendons as they pass on the bones.

*Q.* How are the fibrous aponeuroses divided?

*A.* Into those which are spread out as coverings over parts, and those which afford muscles places for insertion.

*Q.* How are the fibrous organs in form of *fasciæ* divided?

*A.* Into tendons and ligaments.

*Q.* Where are tendons found?

*A.* At the origin, middle, or insertion of muscles.

*Q.* Where do you meet with ligaments?

*A.* Their office being to strengthen the joints, they are met with about the bony or cartilaginous articulations.

*Q.* What is the common centre of the fibrous organs?

*A.* The periosteum.

*Q.* Why is the periosteum thus considered?

*A.* Because, generally speaking, the fibrous organs are attached to the periosteum.

*Q.* What are the principal exceptions to this anatomical arrangement?

*A.* The albuginea of the eye, the membranes of the spleen and liver.

### *Organization of the Fibrous System.*

*Q.* What is the organization of the fibrous system?

*A.* It is a peculiar, hard, slightly elastic fibrous base, destitute of sensibility, and nearly so of contractility. The fibres are, in tendons, in juxta-position; they are so likewise in ligaments. In membranes, the fibres are crossed in every direction.

*Q.* Is the power of resistance in the fibrous system great?

*A.* Sometimes it is even greater than that of the bones, as the patella. Recollect the violence requisite to draw criminals asunder by horses, in the punishments of the ancients.

*Q.* Why are tendons always ruptured, rather than the muscular fleshy fibres?

*A.* Because the fleshy fibre is in such constant contraction and approximation, as to enable the strength of the muscle to exceed that of the tendon.

Q. Why do you doubt the identity of muscular and fibrous tissues?

A. Those tissues cannot be alike which vary so much in chemical composition, in organization, in vital properties, and in functions.

Q. What portions of the fibrous system are most liable to inflammation?

A. In those where there is most vascularity.

### *Properties of the Fibrous System.*

Q. What physical properties belong to the fibrous system?

A. Elasticity, and that quite obscure.

Q. Are there any textural properties in this tissue?

A. Extensibility, which takes place slowly. In their extension, the fibrous organs become sometimes thinner than natural, in other cases they are thicker. Contractility is also seen in these, and it is as slow in development as the extensibility.

Q. Give instances of the extension and contraction of the fibrous system.

A. The dura mater in hydrocephalus; the fibrous organs in the abdomen in pregnancy and ascites; now in the restoration of these parts to their natural size, you see the contractility of the fibrous organs.

Q. What are the vital properties of this system?

A. Organic sensibility and insensible organic contractility; but animal contractility, and sensible organic contractility do not belong to it.

Q. What is the peculiarity of the animal sensibility in this tissue?



*A.* It is that ordinary stimulants do not excite it. It is put in action by violent extension or sudden distention; hence the acute pains of straining, stretching, or twisting the joints or the spine. You will also here bear in mind the severity of pain, when pus is confined by an aponeurosis.

*Q.* Are the vital forces of the fibrous system active?

*A.* Much more so than those of the osseous and cartilaginous tissues; but the forces vary in different parts of it.

*Q.* What remarkable circumstance is observed in inflammation of this system?

*A.* That it does not produce pus.

*Q.* But does not the dura mater suppurate?

*A.* Bichat says it does not; that the pus proceeds from the tunica arachnoides on the dura mater.

*Q.* What sympathies arise from this fibrous system?

*A.* They are various. The animal sensibility of the whole limb may be increased; again, animal contractility of remote parts is excited as in tetanic symptoms from wounds, or in the sardonic grin from punctured diaphragm. At another time you find the organic sensibility of parts is exalted, as when the pericranium is inflamed from sympathy with the dura mater. The sensible organic contractility is disturbed, as when the stomach vomits from wound of the sclerotica, or when the heart is disturbed by fibrous pain.

*Q.* What vital property in the tissues is apt to be excited by sympathetic compressions?

*A.* The predominant vital force of each system.

*Development of the Fibrous System.*

*Q.* What consequence results from the softness and want of resistance in the fibrous systems of early years?

*A.* That luxations are more rare; that sprains are less violent; that the articulations are more extensible than in after life, when the ligaments are stiff and strong. The weakness of the vital forces in this tissue in infantile life, renders it less liable to rheumatism.

*Of the Fibrous Membranes in General.*

*Q.* How are these distinguishable from serous and mucous membranes?

*A.* The fibrous are, with one exception, exactly adapted to the form of the organs they cover; the exception is the dura mater. The two surfaces of these membranes are adherent, and they are perforated for the passage of vessels. Now, in all these respects, they differ from the serous and mucous membranes.

*Q.* Is it certain that the membrane of the corpus cavernosum penis is fibrous?

*A.* Various experiments prove the difference between the membrane of the corpus cavernosum penis and the spongy textures, and substantiate its resemblance to the fibrous tissues.

*Of the Periosteum.*

*Q.* For what is the periosteum remarkable in infancy?

*A.* For its greater thickness, its feeble connexion with the bones, and its softer, more spongy, and gelatinous aspect, than in after life.

*Q.* Is the periosteum continued over the articulations?

*A.* It is not. The ligaments intermix with it, serve as a means of communication, and thus is it continued.

*Q.* What bony parts are destitute of it?

*A.* The crown of the tooth, and the bony projections on the heads of animals.

*Q.* What different morbid processes take place when the medullary substance and periosteum are diseased?

*A.* In the disease of the medullary substance, necrosis seizes the whole bone; in that of the periosteum, the external laminæ are alone affected.

*Q.* What is the direction of the fibres of the periosteum?

*A.* It is that of the fibres of the long and short bones, but not radiated as the fibres of the flat bones are.

*Q.* Are the fibrous organs inserted into the periosteum, or are they more immediately connected with the bone?

*A.* In infancy they are not connected with the bone; but as ossification progresses, it attaches the inner layers of the fibrous organs, and thus firmly supports the powerful action of the muscular lever.

*Q.* What are the uses of the periosteum?

*A.* It protects the bones from the action of surrounding parts: it assumes the ossific process when disease destroys the bones: by the ossification of its inner layers it increases the thickness of the bones: but above all, it affords to the fibrous organs a general, solid, resisting support.

#### *Of the Fibrous Capsules.*

*Q.* Where are they found?

*A.* Almost exclusively on the scapulo-humoral and ilio-femoral articulations.



*Q.* Why are they only found there?

*A.* Because these articulations having equal motion in all directions, require equal support in all directions.

*Q.* What is the use of the fibrous capsules?

*A.* To give strength to the articulations; they do not exhale the synovia.

*Q.* Are the capsules which form around unreduced heads of bones fibrous?

*A.* They are not; no fibres can be traced in them—they are serous.

### *Of the Fibrous Sheaths.*

*Q.* How are they divided?

*A.* Into partial and general.

*Q.* Explain this division.

*A.* The partial are attached to one or two tendons; the general confine or belong to an assemblage of muscles or tendons, as at the wrist and ankle, where the annular ligaments are.

*Q.* What muscles in the limbs have the partial fibrous sheaths?

*A.* Only the flexors; the extensors are destitute of them. The reason of this is the flexors require more strength and support than the extensors.

### *Of the Aponeuroses.*

*Q.* How are the aponeuroses divided?

*A.* Into those for covering and those for insertion.

*Q.* How are the aponeuroses for covering sub-divided?

*A.* Into those for general and those for partial covering.

*Q.* Where are those for general covering found?

*A.* Around the extremities, where they tie down the muscles. These aponeuroses are thick and strong in proportion to the size and action of the muscles they cover. When it is otherwise, as in the gastrocnemii muscles, these muscles are liable to a species of dislocation and cramp.

*Q.* What do you mean by the tensor muscles?

*A.* They are muscles inserted into the aponeuroses for general covering, to tighten or relax them, as the situation of the limb may require.

*Q.* With what tissue do these general aponeuroses peculiarly intermix?

*A.* In some parts of the limbs they are gradually merged or lost in the cellular tissue.

*Q.* What are the uses of these aponeuroses?

*A.* Besides confining the muscles, they by compression favour the circulation of the red and white fluids. Hence dropsy is rarer and later in forming in the sub-aponeurotic cellular tissue than in the superficial.

*Q.* Where are the aponeuroses for partial covering found?

*A.* On the hand, on the back and abdomen, some of the muscles of which they cover and aid.

*Q.* How are the aponeuroses of insertion divided?

*A.* Into those with a broad surface, those in the form of an arch, and those with separate fibres. Those in the arched form are to allow vessels to pass under them.

*Of the Tendons.*

*Q.* Are tendons active or passive in their functions?

*A.* They are passive, being moved by the muscles.

*Q.* At which extremity of a muscle are they usually found?

*A.* At that end of the bone where the motion is greatest.

*Q.* What are the forms of the tendons?

*A.* Some are flat; most of them are round; some are bifurcated. Their union is exclusively with fibrous membranes, never with serous or mucous membranes.

*Q.* What is the organization of the tendons?

*A.* They are a union of fibres, connected by compact cellular membrane.

*Q.* What is the character of their vital forces?

*A.* They are very weak.

*Q.* What muscles are destitute of tendons?

*A.* Those of organic life, and nearly all those of animal life, which form the sphincters.

*Of the Ligaments.*

*Q.* What is the difference in the attachments of the tendons and ligaments?

*A.* One end of a tendon is attached to a muscle, whereas both ends of a ligament are attached to the periosteum.

*Q.* How is it that the ligaments execute a double property?

*A.* By strength they unite the bones, and by flexibility they allow free motions.



Q. To what is club-foot owing?

A. To weakness and relaxation of the ligaments.

Q. What changes does white swelling produce in the ligaments and tendons?

A. A softening, thickening, and consequent impotence in these muscular and cuticular attachments.

Q. Is morbid fibrous tissue ever produced?

A. Frequently in the uterus, vagina, and other parts.

### *Of the Yellow Elastic Tissue.*

Q. What additional division in the fibrous system does Beclard make?

A. He describes what he terms the *yellow elastic tissue*, as it is found in man and animals. It is seen in the vertebræ, in the peculiar membrane of the arteries, in the ligamentum nuchæ of animals, and it supports the abdominal parietes of animals. It is in the cat's claw. This tissue is remarkable for its elasticity. It is not only in the peculiar membrane of the arteries, but in that of the vascular system generally.

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### PATHOLOGY OF THE FIBROUS SYSTEM.

Q. What are the diseases of this tissue?

A. Inflammation; osseous, fungous, cartilaginous, carcinomatous transformation; but these are much modified by the portions of the system affected.

Q. Does rheumatism affect the tendons?

*A.* It is said not; the ligaments are its seats about the joints; the tendons are not painful in rheumatism.

*Q.* Is the dura mater liable to inflammation?

*A.* If so, it is not much disposed to it. Inflammation which has been ascribed to the dura mater was really in the arachnoides.

*Q.* How do you distinguish periosteal tumour from exostosis?

*A.* The tumour of the periosteum is more painful, of more rapid increase, and is softer than exostosis.

*Q.* Is there much difference between inflammation of the periosteum and spina ventosa?

*A.* In the first the bony cylinder of periosteum cases a portion of dead bone; in spina ventosa the diseased and healthy bone are continuous.

*Q.* How does periosteal inflammation terminate?

*A.* It usually ends in suppuration.

*Q.* But as a general observation, how does inflammation of the fibrous tissue terminate?

*A.* In resolution or thickening.

*Q.* How are the cicatrices of the liver formed?

*A.* They are fibrous adhesions.

## OF THE FIBRO-CARTILAGINOUS SYSTEM.

*Q.* Where is this found?

*A.* In the ear, in the alæ of the nose, in the trachea, in the eye-lids. It is found in the spinal inter-articular substance, in the iliac and pubic symphysis, and it appears sometimes as tendinous sheaths.

*Q.* Of what does this system consist?

*A.* Of a mixture of fibrous and cartilaginous substance, of which the former is the base.

*Q.* What are the functions of this tissue?

*A.* It has great power; it preserves the vertebræ, knee, jaw, and other articular surfaces in place. It is in most instances destitute of perichondrium.

*Q.* Does any-other structure enter into the fibro-cartilaginous tissue, than those indicated by its name?

*A.* It has a little, very condensed cellular texture. Few blood-vessels, and no nerves can be seen in this texture.

*Q.* What properties appertain to this tissue?

*A.* The physical are elasticity and suppleness to a great degree: observe these in the spinal column, nose and ears.

*Q.* What are the textural properties of this system?

*A.* Both extensibility and contractility. The nose dilates from tumours and polypus, and contracts slowly when the distention is removed.

*Q.* You have frequently met with and mentioned elas-



ticity, extensibility, and contractility; how do these properties principally differ?

*A.* Elasticity is a rapid, the others are slow actions.

*Q.* What are the vital properties of this tissue?

*A.* Organic sensibility and insensible organic contractility; and these in a degree sufficing only for the nutrition of the tissue. Neither active nor passive sympathies are met with here.

*Q.* Have the fibro-cartilages much disposition to ossify?

*A.* Not near so great as the cartilages. Beclard accurately observes that there are temporary and permanent fibro-cartilages. The first having served their purposes, ossify; the second remain fibro-cartilaginous.

## MUSCULAR SYSTEM.

*Q.* How is the general muscular system divided?

*A.* Into the muscular systems of animal and organic life.

*Q.* In what respects do these differ from each other?

*A.* They differ in the vital forces which animate them; in their external forms; in their mode of organization; and the parts they perform in animal and organic life.

### I. OF THE MUSCULAR SYSTEM OF ANIMAL LIFE.

*Q.* What are its first conspicuous characters?

*A.* The size it attains, and space it occupies; and its agency in, and adaptation to the defence of the vital organs.

#### *Of the Forms of the Muscular System of Animal Life.*

*Q.* How are these muscles divided?

*A.* As the bones are, into long, broad, and short muscles.

#### 1. *Of the Long Muscles.*

*Q.* Where do you find these?

*A.* Generally in the limbs.

*Q.* What external and internal layers belong to them?

*A.* The aponeurosis between them and the skin, and the periosteum between them and the bones, form for them a fibrous sheath, in which they play.

*Q.* Where are the longest of these muscles?

*A.* The external muscles are the longest; the deep-seated the shortest.

*Q.* What separates the muscles from each other?

*A.* Cellular layers are interposed between the muscles.

*Q.* How are the long muscles divided?

*A.* Into the simple and compound. Composed of a single fasciculus, they are single; where fasciculi unite, the muscles are compound.

*Q.* What purpose is served when several of the long muscles are united by aponeurosis?

*A.* The force and direction of muscular power are concentrated.

## 2. *Of the Broad Muscles.*

*Q.* Where are they generally found?

*A.* Covering the parieties of the cavities of the body.

*Q.* What offices do they perform?

*A.* Three; they in some extent contribute to the formation of the parietes; they protect the contained organs; and aid these last in the discharge of their functions by the motions they communicate.

*Q.* Why is cramp never felt in these broad muscles?

*A.* As cramp arises from the displacement of a muscle, and as these broad muscles are not liable to dislocation, they do not suffer from cramp.

*Q.* The circumstance of these broad muscles not being



liable to displacement, accounts for an anatomical fact, what is it?

*A.* They are not often covered with aponeuroses.

### 3. *Of the Short Muscles.*

*Q.* What do you mean by these?

*A.* They are a class of muscles equal in length, breadth and thickness, fitted by this formation for strong yet circumscribed motion.

*Q.* Where are they found?

*A.* About the shoulder and hip joints; about the jaw, the palm of the hand, and so forth.

### *Organization of the Muscles.*

*Q.* What peculiar organization is found in muscles?

*A.* A red, flabby (*molasse*) fibre, with uniformity of size in the large and small muscles, running its course without bifurcation. A single fibre is not visible, but as they are always united in a bundle, they are thus distinctly seen.

*Q.* What constitutes general contraction of a muscle?

*A.* The union of many separate, distinct, and independent contractions.

*Q.* What is the direction of the fibres of the voluntary muscles?

*A.* Straight, except in the sphincters.

*Q.* How does muscular texture differ from fibrous?

*A.* In its softness and small degree of resistance.

*Q.* How then is it that muscles are so rarely ruptured?

*A.* Because the concentrated contraction of a great number of fibres, compensates for the weakness of one.

*Q.* What is the proximate principle, the essence of the muscular texture?

*A.* When by various means you have separated the colouring matter, gelatine, albumen, and saline principles from the muscle, you will have left a gray fibre, which is not soluble in warm water, but is so in weak acids. This fibre gives out much azote when exposed to nitric acid, and it resembles the fibrin of the blood. This substance constitutes the nutritive matter of muscles, as phosphate of lime does that of bones.

*Q.* What relation does this fibrous substance bear to the blood?

*A.* There is, in general, a constant relation between the quantity of this fibrous substance contained in the muscles, and the quantity of it that the blood contains.

*Q.* What organization is common to the muscles and other parts?

*A.* Cellular substance, which abounds greatly, enveloping every muscle, fasciculus, and fibre.

*Q.* What is the use of this cellular texture in the muscles?

*A.* It fixes them in their place, and greatly facilitates their motions.

*Q.* There is another constituent in muscular organization, what is it?

*A.* It is red blood which enters largely into it.

*Q.* Is it the mere circulation of that fluid which colours a muscle?

*A.* No; it is that portion of it which combines with the peculiar muscular texture.

*Q.* Why do you suppose that to be the case?

*A.* Because in asphyxiated animals while black blood circulates, the muscular colouring substance does not become black; and because in many parts which have muscular fibres, red blood circulates freely, yet does not colour the fibres. It is not the mere circulation of red blood which colours the fibres. Another reason is here, that in some animals in which red blood circulates, the muscles are white.

*Q.* In what class of diseases do the muscular vessels allow the escape of blood?

*A.* In diseases of debility; never in those of increased activity.

*Q.* Whence are the nerves of the muscles of animal life derived?

*A.* Almost entirely from the brain and spinal marrow; if there are exceptions, you will find that even there the brain sends a part of the nerves.

*Q.* Are the muscles abundantly supplied with nerves?

*A.* As much so as any other parts. The great nervous trunks run in the direction of the flexors.

*Q.* Are the flexor or extensor muscles the strongest?

*A.* Evidently the flexors; in hysteria, in infantile, and all other involuntary spasmodic motions, the flexors predominate. So they do in old people; under all circumstances the motions of the flexors are most powerful.



*Properties of the Muscular System of Animal Life.*

*Q.* For what are these properties remarkable?

*A.* The muscles have slight physical and conspicuous vital properties. You have heard that the muscles are slightly elastic and soft.

*1. Properties of Texture.*

*Q.* What property of texture is most remarkable?

*A.* Extensibility; and this is in the flexor or extensor, as the one or the other may be passive. Extensibility is confined to the muscular fibre, not extending to the tendons.

*Q.* What morbid phenomena remarkably illustrate this property in the muscles?

*A.* The distention of the muscles with tumours, and that in pregnancy. The aponeuroses have some influence in preventing their distention in the extremities.

*Q.* On what is contractility of texture, so conspicuous in muscles, dependant?

*A.* Not on the action of the nerves, not entirely on life; it is on the structure of the muscles that it essentially depends.

*Q.* How do you distinguish contractility of texture in the muscles from the vital forces?

*A.* Between the extreme points of extension and flexion of the moveable parts of the body there is a resting point, or a middle one. To remove a limb from this point of rest, animal contractility or a vital force must act on the

muscles. Now, as long as this vital voluntary power is in action, the textural contractility of the muscle is overcome. But as soon as this vital force ceases to act, the contractility of texture restores the limb to the medium or resting point. When the will acts on the muscles, vital forces are in play; when it ceases, contractility of texture restores the limb to rest.

*Q.* What is the cause of the extended limbs in typhus fever in its last stages?

*A.* It does not proceed from increased action of the extensors, but from a loss of textural contractility in the flexors.

*Q.* Can you give instances of this contractility of texture in action?

*A.* When a muscle is cut through, the fibres retract considerably; when a woman is delivered, the abdominal muscles return to a natural state by means of this contractility of texture. Repeated distention diminishes this textural property.

*Q.* How does long-continued ascites, affect respiration even after the water has been removed?

*A.* Long-continued pressure of the water on the diaphragm diminishes its contractile power, and dyspnoea continues; so it is after repeated pregnancy.

*Q.* To what is this contractility of texture relative?

*A.* It is in proportion to the length of the fibres of the muscle; it is greatest in the longest muscles, and for this reason in amputation the superficial muscles contract the most. In sleep the legs are most contracted.

*Q.* There is another obvious difference between this contractility of texture and the vital properties, what is it?

*A.* The contractility depends on the development of muscular texture; the vital forces depend on the varying impulses of cerebral nervous energy.

*Q.* What destroys contractility of texture in the muscles?

*A.* Putrefaction; death diminishes, but does not immediately destroy it.

*Q.* What distinguishes this contractility from the horny hardening?

*A.* In the same organ the last is great, the first slight, as in the fibrous organs. Contractility acquires force from life, the other does not. Contractility is lost in the dried organs, the other is not. Contractility is slowly manifested, the other rapidly. The absence of extension excites contractility, but foreign bodies are necessary to produce the hardening.

## *2. Vital Properties of the Muscular System of Animal Life.*

*Q.* Is animal sensibility well marked in healthy muscle?

*A.* It is the most obscure of all the vital properties; pain in cutting a muscle is not severe; irritants do not much excite them; in short, the peculiar texture of the muscle has but little animal sensibility.

*Q.* But there are circumstances in which this property is manifestly conspicuous, what are they?

*A.* In the lassitude from fatigue, and that which precedes many diseases, it is seen. In the first, it warns against continued exertion; in the second, it admonishes of the approach of disease. In the inflammation of the peculiar texture of muscles, this sensibility is most acutely increased, and this differs from lassitude.



*Q.* What vital property is exclusively seated in the muscular system of animal life?

*A.* Animal contractility, on which depend locomotion and the voice.

*Q.* In what does this animal contractility consist?

*A.* In the faculty of moving under cerebral influence, whether this influence is produced by the will, or any other cause.

*Q.* In what general character do the vital properties of animal life differ from those of organic life?

*A.* In this; that the exercise of the properties of organic life is concentrated in the organs, while the exercise of those of animal life depend on the organ, the brain, and the nerves.

*Q.* How do you prove the brain thus essentially connected with the muscular system?

*A.* Causes which increase the energy of the brain have that effect on the muscles, and those which diminish that energy, debilitate the muscles.

*Q.* In what forms are sudden and powerful impressions on the brain manifested in the muscular system of animal life?

*A.* As in convulsions and palsy. Indeed this muscular system indicates the condition of the brain. The muscles are to the brain what the arteries are to the heart.

*Q.* What three great functions have their seat in the brain?

*A.* Perception, voluntary motion, and intellect. These may be separately or entirely destroyed or affected.

*Q.* There are two circumstances which influence the cerebral power over the muscles, what are they?

*A.* The disposition of the nerves to convey this power, and that of the muscles to receive it.

*Q.* Do the nerves proceed directly from the brain to the muscles of animal life?

*A.* Some do, but the greater number go from the medulla spinalis.

*Q.* What evidence is there that the nerves of motion proceed from the medulla spinalis?

*A.* If the medulla spinalis is irritated, convulsions arise; and as this irritation is higher or lower on the medulla, are the superior or inferior parts irritated.

*Q.* Why are injuries of this medulla, at its upper part, so dangerous?

*A.* Because the functions of the diaphragm and intercostal muscles are destroyed.

*Q.* What nerves go directly from the brain to the muscles of animal life?

*A.* Those to supply the tongue, face, and eyes, and some others.

*Q.* Are all the nerves of animal life equally disposed to convey irritation from the brain?

*A.* No; those of respiration are least so, and the wisdom of this is evident. The muscles of the extremities, face, larynx, pelvis, abdomen, intercostals, and diaphragm, are, in the order mentioned, disposed to take on irritation from the brain.

*Q.* In what direction is nervous influence propagated?

*A.* From the superior to the inferior part of the nerve only.

*Q.* What circumstances affecting the muscles, alter the animal contractility of that texture?

*A.* Inflammation, contusion, infiltration of serum; interruption to the flow of blood, for the arterial motion, and that conveying red blood, is necessary to muscular

animal contractility; opium thrown into contact with the muscular texture; all these alter the contractility of the muscles.

*Q.* Repeat the actions necessary to excite animal contractility in the muscular tissue?

*A.* The action of the brain which originates, that of the nerves which propagates, and that of the muscles which receive the principle of motion.

*Q.* What causes acting on the brain produce animal contractility?

*A.* The exercise of the will; and there are involuntary ones which excite this property without the concurrence of, or even in opposition to the will. These involuntary causes are directly applied to the brain, or influence that organ by sympathy.

*Q.* Are these sympathetic impressions always attended with increased determination of blood?

*A.* They are not; it is irritation simply; and this irritation excites the brain to a degree beyond the control of volition, and convulsions ensue.

*Q.* How does fear act on the muscles?

*A.* Through the intervention of the brain, and this fear deprives the brain of its power to originate the impulse of the contractility.

*Q.* How do you account for muscular action in the foetus, where the will evidently cannot act?

*A.* Sympathetic impression, derived from the visceral organs, acts on the brain producing involuntary muscular action or animal contractility.

*Q.* Can you explain the muscular motion after decapitation in man and animals?

*A.* The brain conveys for a short time to the face, and



the nerves from the spine convey to the muscles of the body and limbs, the principle of animal contractility. This circumstance clearly shows the difference between the voluntary and involuntary contractility. So that after decapitation, and by the influence of galvanism, the principle of animal contractility can be conveyed; that is, after intellect and respiration, and the heart's action have irrecoverably ceased.

*Q.* Why is galvanism more powerful after death than during life?

*A.* Because during life the will in a great measure counteracts the irritation of the galvanic fluid.

*Q.* What is the difference between animal contractility and irritability?

*A.* Animal contractility originates in the brain and nerves, and its power is passively received by the muscles. Irritability is an innate principle of motion in a muscle; it exists before and after death.

*Q.* In what part of the nervous system does animal contractility cease first and last?

*A.* It is first lost in the brain, next in the spinal marrow, last in the nerves; and it is excited by metallic irritation when all other is inefficient.

*Q.* By what means can you distinguish sensible organic contractility from animal contractility?

*A.* Recollect that sensible organic contractility is organic action independent of the brain, the animal contractility is purely dependent on the brain. If you cut all the nerves which convey influence to the muscle, still that muscle on irritating it will contract; now this is the sensible organic contractility, the irritability of physiologists.

This irritability actuates a muscle from contractions down to oscillations.

*Q.* What tends most to develop the *sympathies* of this system?

*A.* The great development of animal sensibility in any organ; hence it is that pain so often produces involuntary animal contractility of the muscles, or, in other words, spasms.

*Q.* Is this sympathy direct between the organ and the muscles?

*A.* The pain acts on the brain, and that reacts on the muscles.

*Q.* Do the organic sensibilities and contractilities radiate sympathetic reciprocity through the brain on the muscles?

*A.* No; none but the *animal* sensibility and contractility are sympathetically operative through the brain; the *organic* vital properties operate directly from organ to organ.

*Q.* Is there an anatomical or physiological reason for this?

*A.* There is; for the brain does not influence *organic* vital properties through the nerves, but it does affect the *animal* properties of the muscle.

*Q.* State instances of animal sensibility in the muscular system sympathetically excited.

*A.* Take as instances of this the pain, languor, and lassitude of fever.

*Q.* Do convulsive motions indicate disease of the muscles?

*A.* They do not; they indicate cerebral excitement as the varieties of the pulse indicate affections of the heart.

*Q.* Is the muscular texture very liable to organic disease?

*A.* No; it is but little subject to this. It is seldom that the tumours, or suppurations, or other organic affections, so much met with elsewhere, are found in the muscular texture.

*Phenomena of the Action of the Muscular System of Animal Life.*

*Q.* How do you form your estimate of the force of muscular contraction?

*A.* It is in the ratio of the force of the organization of the muscle, and that of the cerebral excitement.

*Q.* What are the three sources of muscular contraction?

*A.* Irritating the brain in experiments, excitement of the brain in the natural state, and sympathetic influence.

*Q.* Does the rapidity of muscular contraction depend on the number of the branches of the nerves, supplying the muscles, which may be irritated?

*A.* The contractions are as rapid if you irritate one branch, as if all the branches are irritated.

*Q.* Are all the phenomena of muscular contraction identical?

*A.* No; cut a muscle and there is slow and insensible contractility of texture, and this is seen in muscles where the antagonizing muscles are palsied. Then you have the rapid contraction, either voluntary, or from irritation of the nerve; and lastly, you have that oscillation which a chill or fear produces.

*Q.* How do you estimate the effect which a muscle in



the straight direction produces on the bones into which it is inserted?

*A.* Take the direction of the muscle from its fixed to its moveable point, then take the inverse of this course, and you have the direction of the motion.

*Q.* How do you estimate the action of a broad muscle, which is united in a single tendon or point?

*A.* Take the middle line of direction of all its fibres.

*Q.* And how, when the fibres attached at two points form several fasciculi?

*A.* You must estimate the line of the direction of each fasciculus, and then you can decide on the action of the muscle.

*Development of the Muscular System of Animal Life.*

*Q.* What is the colour of the muscles in the foetus?

*A.* The tinge is that of venous blood.

*Q.* What excites the action of the muscles so universally as they are seen to be at the moment of birth?

*A.* The contact of air, which excites the brain to perception of impressions new to it; then the diaphragm is excited to motion, and respiration sends red blood to the brain; this blood proving an additional stimulus to cerebral influence, the constant and active muscular motions of infancy are produced.

*Q.* What effect has disease on the colour of the muscles?

*A.* Acute diseases have little effect; in chronic cases it often becomes pale; in dropsy it is quite pale.

Q. How does age affect muscular contractility of texture?

A. It diminishes it remarkably.

Q. Is the muscular fibre globular, hollow, or solid?

A. Meckel and Home consider it globular; some anatomists suppose it to be an assemblage of vessels of a particular order; others say it is solid and not penetrated by fluids.

## II. OF THE MUSCULAR SYSTEM OF ORGANIC LIFE.

Q. Where do you find the muscles of this tissue?

A. In the thorax, abdomen, and pelvis; and the heart and œsophagus, the stomach and intestines, the bladder and uterus, compose it.

### *Forms and Organization of the Muscular System of Organic Life.*

Q. What are the forms of these muscles?

A. They form hollow muscular cavities; they are without tendons; they do not arise from fibrous membranes, nor are they inserted into them; they proceed from, and terminate in cellular substance; they have a thin, flat, membranous form.

Q. What is the direction of the fibres?

A. It is not single as in the muscles of animal life, but they interlace in every direction.

Q. What advantage is this interlacing of fibres?

A. It favours the diminution of the diameters of the cavities formed by these muscles.

Q. Does cellular substance abound in these muscles?

A. Not at all; very little is found; hence it is that dropsies are not met with in this tissue.

Q. Are blood-vessels numerous here?

A. Yes; blood is found in full proportion in this tissue.

Q. Whence do they derive their nerves?

A. From the cerebral and ganglionic system.

Q. In what organ of this tissue do the cerebral nerves predominate?

A. In the stomach—the par vagum.

### *Properties of the Muscular System of Organic Life.*

#### *1. Properties of Texture.*

Q. For what properties are the organic muscles remarkable?

A. Especially for those of texture, viz. extensibility and contractility.

Q. What is conspicuous in the extensibility of these muscles?

A. The rapidity with which it acts, and the extent of which it is susceptible. Observe this in the distention of the stomach and bladder.

Q. Why are the muscles of animal life incapable of this rapid and great extensibility?

A. Perhaps because they are intersected by numerous aponeuroses, and because the layers of their fibres are very thick.

Q. Do you not find in some of the organic muscles an extensibility of a peculiar kind?



*A.* We do, as in the gravid uterus and aneurismatic heart. It is in these the result of nutrition, where thickness of parietes is added to extension.

*Q.* When is contractility of texture most obvious in these muscles?

*A.* When they are empty.

*Q.* What property or power empties them of their contents?

*A.* Organic contractility; and after this has emptied the hollow muscles, then contractility of texture closes them.

*Q.* What regulates the degree of organic contractility in the organic muscles?

*A.* It is in proportion to the fleshy fibres; hence it is in such activity in the left ventricle of the heart, in the œsophagus, and in the rectum.

## 2. *Vital Properties.*

*Q.* Have the muscles of organic life much animal sensibility?

*A.* It is slight. Harvey found the heart insensible, the bladder is so in living animals.

*Q.* Is lassitude felt in these muscles?

*A.* It is probable that hunger may be partly owing to this. The sensation in the bladder when permanently contracted may be that of lassitude. Perhaps the feeble pulse after long fevers may result from a lassitude of the fleshy fibres of the heart.

*Q.* What have you to say of the animal contractility of these muscles of organic life?

*A.* That from the nature of the property it is foreign

to them. Cerebral influence and irritation are necessary to animal contractility; now, as the will has no influence over these muscles, animal contractility cannot be expected in them. Irritate the brain with the scalpel, with opium, intoxication, wounds of the head, mania, and while all these excite the animal contractility of the muscles of animal life, there being no such property in the muscles of organic life, they are unmoved.

*Q.* But do you not find the brain affected by disorder of the muscles of organic life?

*A.* No—in most vomitings, the irregular motions of the intestines which take place in diarrhœas, in affections of the heart, &c. the brain is not diseased.

*Q.* In syncope is the brain or heart first affected?

*A.* The heart is.

*Q.* The brain does certainly influence the stomach through the par vagum?

*A.* It does; but cutting the par vagum does not affect the stomach as the section of a nerve going to a muscle of animal life, does that muscle. While irritating the par vagum induces the stomach to contract, yet if both nerves of that pair be divided, violent vomiting is induced. Now you never induce contraction in a muscle of animal life by cutting off its supply of nervous influence.

*Q.* Do you consider Bichat's arguments and facts with regard to the independence of the organic muscles of cerebral influence as conclusive?

*A.* No. He is not convinced himself; for a mixed influence is admitted, with the nature of which he is unacquainted; but of one thing he is assured, that the cerebral influence on the organic muscles is entirely different from that on the animal muscles.



*Q.* What property predominates in the muscles of organic life?

*A.* Sensible organic contractility; but organic sensibility is also very conspicuous.

*Q.* How are stimuli divided with reference to the sensible organic contractility of the organic muscles?

*A.* Into natural and artificial. The blood is the natural stimulus to the heart, the urine to the bladder, food and fæces for the stomach and bowels. Artificial stimuli are irritants applied after death, or in experiments.

*Q.* How is the sensible organic contractility of this tissue affected by natural stimuli?

*A.* It is altered by changes in the quality and quantity of fluids. See how the heart is hurried when chyle enters it after digestion, and likewise when fluids are thrown into the veins.

*Q.* Is this sensible organic contractility the same in all the organs?

*A.* It is not. It is peculiar, inasmuch as each organ responds to its peculiar or natural stimuli—such is the blood to the heart, the urine to the bladder.

*Q.* What is the state of this property at different ages?

*A.* It is most active in youth; it becomes less so in adult and advanced life. The action of the heart, bladder, and rectum at these periods of life, will fully illustrate this.

*Q.* Does temperament present different states of this property?

*A.* In different temperaments, you see a predominance of this property, in some over others. Having no common centre or source of influence, as the animal muscles have,



the contractility of the organic muscles is seldom uniform; one organ having a greater quantum than others.

*Q.* Is stimulus applied directly to the organic muscles?

*A.* No; a membrane interposes, as the continuous membrane from the blood-vessels in the heart, the mucous membrane for the stomach and intestines.

*Q.* Does this property remain after death?

*A.* It is obvious after sudden general death; you do not see it after death from chronic disease.

*Q.* In which of the organic muscles is sympathy most frequently and actively developed?

*A.* In the heart, next in the stomach, then the intestines, and lastly the bladder. In this order the sympathetic activity is conspicuous.

*Q.* What are the two modes in which the heart sympathizes?

*A.* By having its action enfeebled, as in syncope, and hurried, as in fever. This increased action is engendered in three ways; by foreign matters mixed with the blood, by preternatural irritability, and by sympathy.

*Q.* What is the sensible organic contractility of the stomach?

*A.* Vomiting.

*Q.* Is bile found in the stomach in health?

*A.* Bichat says he has always found it in animals. Vomiting is not occasioned by the bile, but by a sympathetic action of the fibres of the stomach, to which is doubtless superadded in some cases a sympathetic affection of the mucous lining of the stomach. It is these which occasion vomiting, not the bile in the stomach.

*Q.* What property in a tissue is affected by disease?

*A.* That which predominates in a tissue.

*Q.* Will you illustrate this observation?

*A.* In those textures, the mucous, serous, and cutaneous, for instance, where insensible organic contractility is predominant, acute phlegmasiæ are most common, because this property presides over these acute inflammations. In the organic muscles, insensible organic contractility is feeble, the diseases therefore of these muscles are those of the predominant property, which is sensible organic contractility. Hence acute inflammation *comparatively* rarely attacks the muscular substance of the heart or stomach. Again, animal contractility being predominant in the muscular system of animal life, you find that property deranged in its diseases.

*Phenomena of the action of the Muscular System of Organic Life.*

*Q.* What is to be observed of the force of the contractions of this texture?

*A.* That its action is more uniform than those of the muscles of animal life; this action never being either convulsed or palsied, as that of the animal muscles is.

*Q.* What controls the force of the contractions of the organic muscles?

*A.* Power adapted to function, and the circumstance of there being solid or fluid contents to evacuate.

*Q.* In the animal muscular system antagonizing muscles act in inducing relaxation after contraction, as the triceps and biceps; now as there are no antagonizing organic muscles, how is their relaxation effected?

*A.* Dilatation is, from observation, proved to be as



much an active effort as contraction, in the organic muscles; the powers of both are so intermingled as not to be separable.

*Development of the Muscular System of Organic Life.*

*Q.* Is it the action of the brain at birth which sets the organic muscles into activity?

*A.* The principle has been adopted that these muscles are independent of the brain.

*Q.* What causes then excite them?

*A.* One cause is sympathy with the external skin, which is irritated by the contact of air at birth; another is, the excitement on the beginning of the mucous surfaces, and on the whole lungs, in breathing. Other causes are fluids taken into the stomach, the red blood penetrating the organic muscles, instead of foetal black blood; and lastly, the meconium stimulates the bowels.

*Q.* Does growth in the external parts, and in the organic muscles, cease at the same time?

*A.* No; each part has its period of full growth; the organic muscles are longer in attaining this than others. The organic muscles are not subject to the irregularities of growth, that so remarkably characterize the animal muscles.

*Q.* Why do nutrition and growth vary in different textures?

*A.* Because they depend on the vital forces, which vary in every tissue.

*Q.* Which of the muscular systems is soonest exhausted?

*A.* Both in exercise and life the animal muscular system is soonest exhausted.



*Q.* Does Beclard suppose that the brain influences the organic muscles?

*A.* He thinks it does not ordinarily, but may contingently.

*Q.* What distinguished French pathologist was an instance of the controlling power of the will over one of the organic muscles?

*A.* Bayle could at will suspend the action of the heart.

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#### PATHOLOGY OF THE MUSCULAR TISSUE.

*Q.* What are the diseases of the muscular system of animal life?

*A.* Rheumatism, lassitude, atrophy, and hypertrophy.

*Q.* Is inflammation frequent in the muscular tissue?

*A.* It is not; it arises in the cellular tissue of the muscles.

*Q.* What is to be observed of the diseases of the muscles of organic and of animal life?

*A.* That those of the organic muscles are various, from the variety of organs, and those of the animal muscles are few, from the uniformity of the texture.

*Q.* What are the diseases of the heart?

*A.* Inflammation, acute and chronic; syncope; palpitation; aneurism; rupture.

*Q.* What is the pathology of syncope?

*A.* It is a loss of contractility in the heart.

*Q.* What do you observe of the intermittent pulse in fever and disease of the heart?

*A.* That pulse is more dangerous in fever than in disease of the heart.

*Q.* What are the causes of palpitation?

*A.* It arises from fulness of blood; from excitation of the heart by mental emotion; from obstruction to the passage of blood through the lungs; it proceeds also from mechanically distended stomach.

*Q.* How do you distinguish suffocation caused by the heart, and that produced by the lungs?

*A.* In that caused by the heart, the patient cannot bear the recumbent posture, there is violent dry cough. When the patient lies down, the heart presses against the lungs, and occasions the suffocation.

*Q.* What is the seat of polypus of the uterus?

*A.* It is either on the mucous surface, or arises from the muscular tissue of the uterus.

*Q.* What muscles are least affected with rheumatism?

*A.* The abdominal.

*Q.* What symptom attends diaphragmatic rheumatism?

*A.* Hiccup.

*Q.* What occasions atrophy of the muscles of animal life?

*A.* Paralysis, tying up the artery which supplies the muscle.

## MUCOUS SYSTEM.

*Q.* Why is this called the mucous system?

*A.* From the fluid which is found on the surface of the tissue which composes it.

### *Of the Divisions and Form of the Mucous System.*

*Q.* In what form does this texture appear?

*A.* Always in a membranous form.

*Q.* Where are these membranes found?

*A.* They line all the interior surfaces which communicate externally.

*Q.* How are these membranes generally divided?

*A.* Into the gastro-pulmonary and genito-urinary.

*Q.* Is there no mucous tissue which is not embraced in these two divisions?

*A.* There is a small mucous surface in the tubes of the nipple.

*Q.* Give a general view of the gastro-pulmonary mucous membrane.

*A.* It lines the mouth, nose, anterior face of the eyes, the ducts of the glands of the mouth and throat; it lines the Eustachian tube, the trachea, lungs, the œsophagus, stomach, the biliary, pancreatic and cystic ducts, the intestines, and finally unites with the skin at the rectum.

*Q.* Give a similar view of the genito-urinary mucous membrane.

*A.* This is spread in men on the urinary canals up to



the kidneys, along the seminal ducts and tubes; and in women on the urinary canals, on the vagina, uterus, and fallopian tubes, and by the opening of these tubes it communicates with the peritoneum.

*Q.* Is it common for the mucous and serous membranes to communicate?

*A.* This just stated is the only instance.

*Q.* State some interesting pathological considerations which refer to these two mucous surfaces.

*A.* The diseases of these two great divisions of the mucous membranes are distinct, and sympathies radiate between them comparatively rarely. But there are sympathies which play between them deserving recollection, such as that between the utero-mucous and pulmonary mucous surfaces, constituting vicarious hæmorrhage from the lungs when menstruation is interrupted. The translation of gonorrhœa to the mucous membrane of the eye is another instance.

*Q.* Will you state some curious sympathetic irritations which arise in the courses of these two divisions of the mucous system?

*A.* The irritation at the end of the penis occasioned by a stone in the bladder is one, and the itching of the nose occasioned by worms on the intestinal surface is another.

*Q.* How many surfaces are presented by each mucous membrane?

*A.* Two; an adherent one to the neighbouring organs, and a free villous one.

*Q.* What are the uses of the adherent mucous surface?

*A.* By its adhesion to the muscles of organic and animal life, it has a constant agitation, favourable to the secretion of mucus; it gives form to the organ it lines; it gives force

to the mucous surface, and it resists the contents of the mucous cavities.

*Q.* Will you name an important aspect in which the mucous system deserves here to be considered?

*A.* It is the constant exposure of the mucous surfaces to foreign bodies and matters; the tissue serves to defend organs from the contact of these bodies; in this office it is to the internal organs what the skin is to the external.

### *Organization of the Mucous System.*

*Q.* What is the mucous chorion?

*A.* The layer and papillæ of the free surface.

*Q.* What is the texture lining the ear?

*A.* Its continuity with the pituitary membrane, its mucous discharge, its diseases, its want of fibres, prove it to be mucous tissue.

*Q.* Where is the mucous chorion thickest?

*A.* In the gums and palate; it is finest in the sinuses of the face and internal ear. Diseases thicken it very much.

*Q.* What is its texture?

*A.* It is soft and thick, like velvet, in the stomach and intestines; as it approaches the external openings, it becomes denser. The extreme softness of the texture in the internal organs will not allow of the variolous pustule; these pustules appear on the mucous surface, where its density will support their structure.

*Q.* Where is the mucous chorion of the deepest colour?

*A.* In the stomach, where blood gives it this colour; it is paler in the bladder and rectum.

*Q.* What effect have the mucous surfaces on milk?



*A.* The dried membrane coagulates it.

*Q.* In what is the peculiar sensibility of the mucous texture seated?

*A.* In the papillæ of the mucous chorion.

*Q.* In what part of the mucous tissue does functional power, such for example as the secretion of gastric juice, reside?

*A.* In the vascular net-work at the base of the villi, not in the villi themselves, as has been supposed. The villi are adapted to sensibility, not to secretion.

*Q.* What experiment decided the function of the villi?

*A.* Irritate the villi after removing the epidermis, and great pain is felt; introduce an instrument so as to irritate the internal surface of the chorion, and no pain is felt. The base of the papillæ is nervous, and the papillæ receive the impression of foreign bodies.

*Q.* Are these papillæ susceptible of erection?

*A.* Certain portions, as the tongue and nose, are supposed to have an erectile capacity, somewhat resembling the corpus cavernosum penis.

*Q.* Whence proceeds the mucus which lines this texture?

*A.* From the glands called mucous. They are found under the chorion; they are largest in the velum palati and mouth, and they are rounded in form.

*Q.* What difference is observable in the serous and mucous fluids?

*A.* The mucus is secreted; the serum exhaled.

*Q.* If the glands are seated beneath the chorion, how are they excited to secretion by foreign bodies?

*A.* These bodies irritate the extremities of the ducts which convey the mucus, and thus the glands are irritated.



Q. What becomes of the mucus which is poured out so freely?

A. It is evacuated from the various outlets; it is entirely excrementitious.

Q. What pathological consideration is inferred from the vast quantity of mucus secreted?

A. Amongst others this, that the secretion, when suppressed, must give rise to disease.

Q. What general difference is observed in the destination of secreted and exhaled fluids?

A. Secretions are excrementitious; exhaled fluids are recrementitious. One of many proofs of the excrementitious tendency of mucus, is the uneasiness an accumulation of it occasions, and the efforts by coughing to remove it.

Q. Is this texture full of blood-vessels?

A. It receives a great many blood-vessels.

Q. Where is it most red?

A. In the stomach; and the colour depends on a network of blood-vessels, which penetrate the mucous chorion spread on its surface, and embrace the papillæ.

Q. What results from the superficial situation of the blood-vessels?

A. The frequency of hæmorrhage from the mucous tissue.

Q. What arises from long exposure of portions of the mucous surface to the air?

A. It is brought to resemble the skin; in certain cases of vaginal prolapsus, hermaphrodism has been affirmed.

Q. Is there any reason to believe that the redness of the mucous membranes is owing to the blood being oxygenated through their surfaces, as it is in the lungs?

*A.* Experiments contradict the supposition.

*Q.* Does the redness of this tissue depend on the blood circulating in the arteries?

*A.* It does not; it arises from the colouring matter of the blood combined with the texture.

*Q.* Why is it of so much importance to know the normal colour of the mucous membranes?

*A.* In order to decide on their pathological state.

*Q.* How do the exhalents on this texture favour hæmorrhage?

*A.* By the course being so very short from the artery, through the exhalent, to the mucous surface. From this it is inferred that hæmorrhage is from exhalation and not from rupture; and hæmorrhage is incomparably more frequent from this, than from other textures.

*Q.* What forms the pulmonary perspiration?

*A.* A considerable portion of it is a solution of the mucous fluid which lubricates the bronchiæ.

*Q.* How is absorption evidenced in this texture?

*A.* By the absorption of chyle and fluids swallowed, on the intestinal surfaces; by the absorption of morbid matters; by the absorption of the urine in the bladder; by the absorption of turpentine vapours on the bronchial surface.

*Q.* How do the mucous and serous absorptions differ?

*A.* Exhalations and absorption are relative to each other, and regular on the serous surfaces; but not so on the mucous.

*Q.* What nerves supply the origins of the mucous surfaces?

*A.* Where these surfaces are in relation to external bo-



dies like the skin, the cerebral nerves go to them; otherwise the mucous nerves are ganglionic.

*Q.* Recapitulate the organization of the mucous tissue?

*A.* It consists of an adhering sub-mucous cellular coat, of a free surface, a mucous chorion, a vascular net-work composed of blood-vessels, nerves, exhalents, mucous glands, and papillæ.

### *Properties of the Mucous System.*

#### *1. Properties of Texture.*

*Q.* What properties of texture are manifest in the mucous tissue?

*A.* Extensibility and contractility are evident, but these are unequally active in the tissue. The stomach and bowels possess them to a great degree; the ureter is more distensible than the urethra.

*Q.* When fluids cease to pass through the mucous canals, what takes place?

*A.* They contract, but never adhere. When blood ceases to pass through an artery, it closes and becomes ligamentous; not so with the mucous canals. What bad consequences must result if there existed in the bowels or urethra a disposition to close.

#### *2. Vital Properties.*

*Q.* What are the active vital properties of the mucous tissue?

*A.* Animal sensibility is essential and conspicuous. In the perception of odours, on the vaginal and urethral sur-



faces, and on the glans penis, it is much more acute than on the skin.

*Q.* Why is animal sensibility so manifest on this tissue?

*A.* In order to watch the impression of foreign bodies, to the contact with which it is constantly liable.

*Q.* What effect has habit on the animal sensibilities of the mucous tissues?

*A.* It renders sensations which are at first painful, either indifferent or pleasant, and vice versa. As you advance in life, repeated and habitual contact diminishes the sensibility of the tissue.

*Q.* Why is it that the gall-bladder does not perceive bile?

*A.* Because habit and uniformity of perception allow no comparative sensations.

*Q.* What effect has disease on the animal sensibility of this texture?

*A.* It raises it considerably, but never to such exaltation as is felt in the serous and cellular tissues.

*Q.* Is there much animal contractility in the mucous tissue?

*A.* There is none.

*Q.* What organs feel most acutely in disease?

*A.* Those which feel least in a natural state.

*Q.* What properties of organic life are conspicuous in the mucous tissue?

*A.* Both organic sensibility and insensible organic contractility; and these are kept in activity by the nutrition, exhalation, absorption, and secretion, which go on in these tissues.

Q. What is remarkable of the properties alluded to in the last answer?

A. That they are liable to higher degrees and greater varieties of exaltation than in other tissues. From this fact results the consequence that these tissues are subject to a variety of diseases.

Q. How does Bichat divide the sympathies of this texture?

A. Into active and passive. In the first it influences other parts; in the second it is influenced by those parts.

Q. Repeat the general law of sympathies, which we have more than once alluded to.

A. That they act on the predominant vital properties of a part; for instance, exciting animal sensibility where that predominates, or animal contractility, or sensible organic contractility, according as the one or other may be the principal vital property.

Q. It is important to recollect the active sympathies of the mucous surfaces, will you give illustrations of them?

A. Irritation on the pituitary membrane excites the *animal contractility* of the diaphragm to sneezing. *Animal sensibility* is excited sympathetically at the glans penis, by a stone irritating the mucous membrane of the bladder; the same vital property is in action when worms in the intestines induces itching at the nose. The semen passing the urethra, excites the *sensible organic contractility* of the heart to increased action; the same vital property in the stomach is exalted in the vomiting occasioned by the irritation of a stone on the lining membrane of the pelvis of the kidney. You see a sympathetic excitement of *organic sensibility* and *insensible organic con-*



*tractility*, when a sialogogue acting on the extremity of the salivary duct, induces a discharge of saliva from the glands; another instance of this sympathy is, when the mucous membrane on the tongue is furred in consequence of disordered stomach; and lastly, a very remarkable sympathy of these properties with the mucous membranes is, when the cutaneous organ sympathizes with them during digestion. To the sympathies of insensible organic contractility and organic sensibility, are to be ascribed the hæmorrhages which one mucous tissue assumes vicarious to those of another portion of this texture.

Q. In passive sympathies this tissue is influenced by diseases of other textures, give examples of this.

A. In several diseases of other tissues you have burning sensations in the mucous membranes of the mouth, bowels, and stomach; in some cases there is great thirst. Now, in these cases the *animal sensibility* of the mucous tissue is in passive sympathy. Again, the influence of cold applied to the skin, on hæmorrhage of the mucous tissue, is a passive sympathy of the *insensible organic contractility*; so likewise are the catarrhs from exposure to cold, and the effect of warm bathing in catarrh; also the disorder of certain portions of the mucous membrane in some diseases, as that of the throat in eruptive cases; lastly, the diarrhœa in chronic diseases, and the pectoral hæmorrhages in the last stages of organic diseases; these are all passive sympathies of the insensible organic contractility of the mucous membranes.

Q. Why are there not sympathies of the other vital properties in the mucous texture?

A. Because these properties are either not in existence,



or are not the predominating ones of the texture; for you know sympathies play upon the predominant vital properties of a tissue.

*Q.* State the most important characters of the vital properties of this texture.

*A.* They are constantly active; each portion of the tissue has its peculiar modification of vital properties in consequence of peculiar organization; and from these varieties in the vital forces result the various diseases of this tissue.

*Q.* Can you explain what you refer to the peculiarity of the vital forces?

*A.* One stimulus exalts those of the pituitary membrane, another those of the urethra, while a third increases those of the stomach. The vital force of each is in relation to its peculiar stimulus.

*Q.* Is the mucous secretion alike in all parts of the tissue?

*A.* In different parts of the texture it is very different both in health and disease.

*Q.* What part of the mucous system has the most extensive range of sympathies?

*A.* That of the stomach; the least affection of which organ induces by sympathy the greatest uneasiness.

*Q.* But is it the mucous membrane of the stomach which is the source and seat of the active and passive sympathies?

*A.* The other tissues of the stomach, such as the serous and muscular, have common organization, while that of the mucous is peculiar. Hence it is probably the seat of normal and abnormal sympathy.

*Development of the Mucous System.*

*Q.* Is there any thing remarkable in the development of the mucous surfaces at the various periods of life?

*A.* It is highly important that the physician should recollect the following circumstances:—the sudden impulse given to the vital forces of this tissue at birth, when the meconium and urine stimulate to their discharge; that the soft delicacy of the mucous tissues of the stomach, lungs, and bowels, may render children so liable to cough, vomiting, and diarrhœa; that hæmorrhages from this texture in youth are very active; that the colour of the mucous membrane is bright red till the thirtieth year; that this colour varies greatly in redness, and that at particular periods of life the gastro-pulmonary and genito-urinary mucous tissues are in especial susceptibility to disease.

*Q.* Why are contagious diseases less liable to be taken at advanced periods of life?

*A.* Because the mucous membranes are less irritable, and not so susceptible of disease as in youth.

*Q.* What does Beclard consider as the structure of the papillæ or villi?

*A.* That they are a net-work of vessels of the form of leaflets, slightly curved round each other, but it is not clearly shown whether they have orifices or not.

*Q.* What is meant, according to Beclard, by the mucous follicles?

*A.* They are what have been improperly termed mucous glands. Instead of being glands, they are inversions under the free surface of the membrane in which they are formed; they are folded, form a cul-de-sac, and end in an

opening on the free surface. They vary much in size; they are simple or compound.

*Q.* What do you understand by the alveolar structure of the mucous tissues?

*A.* They are small superficial cavities found in the gastric and intestinal mucous surface by Mr. Hewson, and more accurately described by Mr. Home. They are called alveolar from their resemblance to the cells of bees.

*Q.* How do they differ from follicles?

*A.* In this, that their mouths are broader than their bottoms.

*Q.* State an important fact as to the follicles and alveoli.

*A.* It has been ascertained that in herbivorous animals, the follicles are more complicated in structure, and secrete a more active juice. In carnivorous animals they are more simple, and resemble alveoli. In omnivorous animals, in man, they are of both kinds on the mucous surface.

*Q.* How does follicular secretion differ from glandular, and from exhalation?

*A.* In follicles, the secreted fluid is brought directly by the extremities of the arteries; the secreted fluid remains in the follicular cavity to be elaborated before it is thrown out on the organ.

*Q.* What is the nature of the membrane lining abscesses and fistulæ?

*A.* They are evidently mucous.

*Q.* Under what circumstances do mucous canals close?

*A.* When by any cause an inflammation arises which destroys the mucous surfaces; then the parts in contact cicatrize.



## PATHOLOGY OF THE MUCOUS TISSUE.

*Q.* What are the diseases common to all the mucous tissues?

*A.* Increased action to inflammation; mucous discharge; hæmorrhage; aphthæ; and fungous excrescences.

*Q.* Are all the increased mucous discharges from inflammation?

*A.* They are not; both irritation and relaxation will produce them.

*Q.* What are the inflammations or catarrhs of this tissue most usually produced by?

*A.* By atmospheric changes.

*Q.* How do these changes act?

*A.* Directly on some of the mucous tissues, and by means of cutaneous sympathy on others.

*Q.* What is the character of the pain in these membranes?

*A.* It is not lancinating or severe, as in other tissues.

*Q.* What effect has mucous inflammation on the neighbouring cellular texture?

*A.* That texture is not excited to inflammation by mucous disease, as in the diseases of other tissues.

*Q.* What is the colour of the mucous membranes in inflammation?

*A.* They are from a rose colour to deep brown; this colour is sometimes arborescent, and sometimes in dotted points, when the villi are inflamed; lastly, the colour is in red spots.

*Q.* How do these inflammations terminate?

*A.* Not in adhesion, but in mucous discharges, or

mucopurulent; in hæmorrhage; in thickening of the mucous membranes. They terminate rarely in gangrene. This does take place in angina.

*Q.* There is one remarkable termination omitted.

*A.* It is the formation of membranes—as in croup and in the intestines.

*Q.* Is the morbid mucus alike in all the membranes?

*A.* It is not; it varies in them very much; and even in the same membrane at different periods the mucus is of different colour and nature, becoming pus.

*Q.* When mucous membranes are, from any unnatural cause, disused, what takes place?

*A.* They contract and close.

*Q.* What is the nature of the membrane lining fistulæ?

*A.* It is mucous.

*Q.* On what do the morbid growths and enlargements on the mucous membranes depend?

*A.* On morbid action and development of the mucous capillaries, from long-continued irritation and chronic inflammation.

*Q.* What are the causes of mucous hæmorrhage?

*A.* They are from exhalation and disorganization, not from rupture.

*Q.* Whence may exhalation of blood in mucous membranes arise?

*A.* From an exaltation or diminution of the vital forces of the membranes. Hence the active and passive hæmorrhages.

*Q.* What is the pathology of aphthæ?

*A.* They are either little tubercles ulcerated, or small tumefied glands.

Q. What are fungi of the mucous membranes?

A. They are thickenings of the mucous parietes.

Q. What general division of the diseases of this tissue do you make?

A. The idiopathic and symptomatic.

Q. What are the diseases of the *conjunctiva*?

A. Ophthalmia and fungus.

Q. Name the diseases of the *pituitary membrane*.

A. They are coryza, ozæna, polypi, abscess in the malar antrum, and inflammation of the Eustachian tube, and hæmorrhage.

Q. What renders the pituitary membrane so liable to hæmorrhage?

A. Its great vascularity.

Q. How do you divide polypi of this membrane?

A. Into the vesicular and hard; the last is most dangerous.

Q. Is the mucous membrane of the *mouth* prone to inflammation?

A. It is less so than any of the mucous surfaces.

Q. What persons are most liable to aphthæ?

A. Children, and those who at any age have chronic diseases.

Q. There is another disorder to which the mucous membrane of the mouth is little disposed, what is it?

A. Hæmorrhage rarely proceeds from it.

Q. What active sympathy does this mucous surface maintain?

A. That of the tongue with the stomach.

Q. To what are the foul tongue and the black tongue owing?



*A.* To disease of the subjacent glands of the mucous membrane or of the tongue.

*Q.* What affection most frequently appears on the membrane of the pharynx?

*A.* Venereal ulceration.

*Q.* Name the principal diseases of the *laryngeal* mucous surface.

*A.* Croup, and laryngeal phthisis.

*Q.* Where is the force of the last disease expended?

*A.* Originating in the mucous membrane, it fixes on and destroys the arytenoid cartilages by ulceration.

*Q.* What are the general pathological states of pulmonary catarrh?

*A.* Those of acute and chronic mucous inflammation.

*Q.* Name another frequent disease of the *pulmonary* mucous membrane.

*A.* Hæmoptysis, which ends in phthisis.

*Q.* What are the diseases of the *gastric* mucous membrane?

*A.* It has its catarrhal state. You find also the hæmatemesis, and cancer; if indeed the last arises from the mucous surface.

*Q.* To what affections is the *intestinal* mucous membrane liable?

*A.* To acute and chronic diarrhœa and dysentery. Hæmorrhage does not often occur there.

*Q.* In what part of the intestinal tract do you find cancer?

*A.* Chiefly about the rectum.

*Q.* Whence is tympanites?

*A.* It is a collection of air in the bowels; the gas is secreted from the mucous membrane.

*Q.* There are two causes for *gonorrhœa*, what are they?

*A.* The disease is from ordinary and specific causes. Gonorrhœa from filth, illustrates the first; that from syphilis, the second.

*Q.* Where is gonorrhœa seated?

*A.* It is a disease of the mucous glands. Recollect the fluor albus in females.

## SEROUS SYSTEM.

Q. Why is it so called?

A. From the kind of fluid that constantly lubricates one of its surfaces.

### *Of the Extent, Forms, and Fluids of the Serous System.*

Q. Name the principal serous membranes.

A. They are the peritoneum, the pleura, the pericardium, the arachnoides, the tunica vaginalis testis.

Q. What form does the serous tissue assume?

A. Always that of membrane.

Q. What distinctive observation here arises between the serous and mucous membranous expansions?

A. The serous membranes are spread out over the external surface of the organs; the mucous membranes line the interior of the organs.

Q. Which is the most extensive system of the two?

A. The serous tissue.

Q. Mention another distinguishing trait in these two tissues.

A. The serous tissues pour out, by *exhalation*, an albuminous fluid; the mucous tissues *secrete* mucus.

Q. Does the serous surface exceed the cutaneous in extent?

A. It does; it is even probable that the serous exhalation exceeds in quantity the fluid prepared on the cutaneous and pulmonary surfaces collectively.



*Q.* Is serum an excrementitious fluid?

*A.* Entirely the reverse; it is recrementitious.

*Q.* What is the form of each serous membrane?

*A.* That of a sac without an opening; like a double night-cap folded within itself.

*Q.* Into how many parts can a serous membrane be divided?

*A.* Remembering that it is continuous, it may be divided into the membrane that lines the inner surface of a cavity, and that which invests the outer surface of the organs contained in that cavity. Take for illustration the costal pleura and the pulmonary pleura.

*Q.* What do you understand by the free and adherent surfaces of the serous membranes?

*A.* The adherent surface covers the organs; the free surface the interior of the sac.

*Q.* What is Bichat's doctrine of organic life?

*A.* That each organ has its peculiar life, resulting from a particular modification of its vital forces; this modification establishing one in the circulation, nutrition and temperature of each organ.

*Q.* Is any influence on these separate lives produced by the serous investitures?

*A.* The serous membranes so insulate the organs as to favour the theory and operation of separate lives.

*Q.* What influence have the serous investments on the spread of diseased action from one organ to another?

*A.* They are unfavourable to such extension of morbid action.

*Q.* In what pathological point do the serous and mucous tissues conspicuously differ?

*A.* In their respective dispositions to form adhesions.

You will observe that the serous surfaces are as prone to adhere, as you have seen the mucous tissues reluctant to do so.

*Q.* Where are these serous adhesions most frequently found?

*A.* They occur most frequently in the pleura. They are seldom met with in the tunica arachnoides.

*Q.* These adhesions vary much; will you describe some of these varieties?

*A.* Sometimes they are so extensive and close as to form but one membrane; again they are loose and easily separable. Then you will see elongations from the fixed to the free serous surface, these elongations have canals in them. Bichat thinks these elongations are original formations, not the result of diseased action; and lastly, there are adhesions of cellular layers, without these canals.

*Q.* What is to be observed of the connexions of the serous and mucous membranes in disease?

*A.* That as their organization differs, and as their vital forces vary, they are distinct and unconnected in disease.

*Q.* What is the nature of the serous fluids?

*A.* It is a dew, a halitus in health; the serum is albuminous in its nature. In disease it is found changed to pus, albuminous flakes, bloody, and fluids of various other colours.

### *Organization of the Serous System.*

*Q.* What are the characters of the organization of serous tissue?

*A.* It is a single, transparent, whitish, shining mem-

brane. It differs from the mucous tissue in having but a single layer.

*Q.* What is the nature of this membrane?

*A.* It is cellular. It has the common organization of the cellular tissue, without any peculiar structure; it has not, for instance, any peculiar structure, such as the muscles have in their fibrin, or as the bones have in their phosphate of lime.

*Q.* What proof have you that this serous tissue is cellular?

*A.* It is proved to be so by the identity of function and that of disease; it is cellular, because it is inflated or infiltrated by air; and in the process of maceration, the absence of fibrous structure proves negatively the identity of the serous and cellular tissues.

*Q.* What gives to some parts of the body a deeper black in putrefaction than others?

*A.* The blackness in putrefaction depends on the quantity of blood in the putrefied part.

*Q.* In what pathological points do the serous and cellular tissues differ?

*A.* In the first, being subject to a slow inflammation producing tubercles, and in the circumstance that the serous pus differs from that in the cellular texture.

*Q.* What are the parts common to the serous membranes?

*A.* Exhalents, absorbents, and blood-vessels.

*Q.* Are the blood-vessels numerous?

*A.* No; in health they are few and small.

*Q.* What shows the existence of exhalents in this tissue?

*A.* Expose a serous surface in the living animal, wipe



it dry, and you will very soon see it covered with new serum from the exhalents.

Q. How will you have a view of the absorbents?

A. Macerate a beef's heart for several hours in water, and you will see its serous surface covered with absorbents; this among other modes of showing them.

Q. What varieties of organization do the serous tissues present?

A. Perhaps each membrane has its peculiar structure. There is the thin, soft, tender arachnoides; the thick, compact peritoneum.

Q. What pathological principle do you derive from this variation in structure?

A. Diversity in disease; greater or less liability to acute and chronic inflammation.

Q. To what peculiar affection is the pericardium subject?

A. To the formation of thick white layers on its internal surface; such as are not found elsewhere in the serous surface.

Q. What tissues are exclusively the seats of serous effusion?

A. The serous and synovial textures.

### *Properties of the Serous System.*

#### *1. Properties of Texture.*

Q. Do the serous membranes manifest much extensibility?

A. From the dilatations they undergo, you would sup-

pose the tissue was very extensible. Not so, however; for in these dilatations the folds of the serous membranes are developed, or there is a kind of displacement of these membranes. This is the case in ascites and pregnancy. The texture is but slightly distensible.

Q. Under what circumstances are these displacements of the serous membranes painful?

A. They are severely so in inflammation.

Q. What have you to say of the contractility of this texture?

A. That it is evident, though not very great. It is evident in hydrocele and ascites after the water is evacuated. After long and repeated distention these membranes lose their contractility.

## 2. *Vital Properties.*

Q. What vital properties predominate in these tissues?

A. Insensible organic contractility and organic sensibility. The other vital properties are wanting.

Q. What effect has disease on these properties?

A. By it they are so exalted as to give acute pain, and the texture of these membranes is readily changed.

Q. When the serous tissues sympathize with affections of other organs, where is the effusion of serum found?

A. In the serous cavity nearest the affected organ; as in the chest when the heart is diseased.

Q. What distinction does Bichat draw between idiopathic and sympathetic serous disorder?

A. In the idiopathic disorder, the exhalents and absorbents of the texture are in a diseased state; in the sym-

pathetic they are not. In the idiopathic the serum is greatly altered in colour, consistence, &c.; in the sympathetic the serum is healthy.

*Development of the Serous System.*

*Q.* How does the development of the serous tissues progress?

*A.* In proportion to that of the organs they cover.

*Q.* Which is earliest and most rapidly developed?

*A.* The arachnoides, and hence hydrocephalic effusion is so frequent in infancy: next in development is the pleura, hence the frequency of pleurisy in youth.

*Q.* What alteration in form often takes place in diseases of the serous tissues?

*A.* They become in some cases much thicker, and in others thinner than in their healthy state.

*Q.* Why is it of practical importance to know the displacements of the serous membranes?

*A.* Because in these displacements there is a change in the relations of parts.

*Q.* What is the nucleus of the various tubercles, tumours, &c. which are seen in such numbers on the serous membranes?

*A.* The nucleus is formed by a concretion of albumen which becomes vascular.

*Q.* In what points do hydatids and cysts differ?

*A.* Cysts are connected with surrounding parts by cellular substance and blood-vessels; hydatids are not. The parietes of cysts have a degree of consistence which hydatids do not exhibit. Hydatids have granular substances on some part of their surface; cysts have not.



## PATHOLOGY OF THE SEROUS TISSUE.

*Q.* Give a general division of the serous diseases.

*A.* They are idiopathic or essential, and sympathetic.

*Q.* What is the most frequent disease of this tissue?

*A.* Inflammation, acute and chronic.

*Q.* Are all the membranes equally disposed to inflame?

*A.* No; they exhibit this disposition in the following order, viz. the pleura, peritoneum, pericardium, tunica vaginalis, and the arachnoid membrane.

*Q.* What is the most frequent cause of serous inflammation?

*A.* Suppressed perspiration.

*Q.* What conspicuous symptoms attend serous inflammation?

*A.* A peculiar lancinating pain and great fever.

*Q.* What is the common termination of serous inflammation?

*A.* It is by adhesion; and this takes place by a new membrane, or by an elongation of fibres, or by contact and blending of the surfaces of the membranes.

*Q.* What is the order of liability, in the serous membranes, to this adhesion?

*A.* It is as follows: the pleura is most given to form adhesion, next the peritoneum, then the pericardium, the tunica vaginalis, and lastly the arachnoides.

*Q.* As serous inflammation terminates in effusion and suppuration, what fluids are found in the sacs?

*A.* It sometimes resembles milky serum, sometimes it has flakes swimming in the serum; the serum is again bloody; and lastly there is pus.

*Q.* What indicates the formation of pus in the serous sacs?

*A.* Alteration of the pain from its acuteness; there is a sensation of weight, and the symptomatic constitutional signs of the suppurative process.

*Q.* In which serous tissue does gangrene oftenest appear?

*A.* In the peritoneum; but observe that the blackest peritoneum is not always the most gangrenous.

*Q.* There is another important and common termination of acute serous inflammation which has not been named.

*A.* It is the chronic inflammation. You will recollect that this is very often an original form of disease, as well as a consequence of the acute serous inflammation.

*Q.* Is chronic inflammation of the serous membranes habitually extended from one to another?

*A.* Very rarely; but observe the continuous affections of the mucous membranes.

*Q.* What is the character of the pain in chronic inflammations of the serous membranes?

*A.* It is an obscure, pricking pain.

*Q.* What is the most interesting pathological result of this chronic inflammation of the serous membranes?

*A.* Dropsy; the correct pathology of which is, that it is a chronic inflammation of the serous membranes.

*Q.* Can you point out a difference in the symptomatic and idiopathic dropsies?

*A.* When dropsy is symptomatic of an organic disease, the *cellular* tissue is infiltrated; but when idiopathic, it is in the serous cavities alone.

*Q.* What fluids are deposited in dropsy?

*A.* Serum, bloody serum, greenish serum, serum with flakes, blood itself.

*Q.* What is the autopsic demonstration in the serous tissues after chronic inflammation?

*A.* They are slightly thickened and swollen.

*Q.* There is yet another pathological state of the serous membranes.

*A.* Yes. They are the seats of miliary eruption; this is especially true of the peritoneum. In these cases the membrane is red, and the disease arises from repelled eruptions and from cold.

*Q.* What is the first pathological process in the course of serous inflammation?

*A.* It is to check the exhalation of serum.

*Q.* What is the most frequent sympathetic disease of the serous membranes?

*A.* Dropsy; which arises either from the disease of the organ invested with serous membranes, or from the debility of protracted organic disease, as consumption. The last are passive exhalations of serum.

*Q.* What serous membranes are most obnoxious to symptomatic dropsies?

*A.* The peritoneum, the pleura, and the pericardium, in the order in which they are named.

*Q.* What are the diseases of the pleura?

*A.* Acute and chronic inflammation.

*Q.* Why is acute pleurisy so frequent?

*A.* This frequency is occasioned by proximity to the lungs, which are so constantly exposed to the air; another cause, the susceptibility of the pleura to take on disease from suppressed perspiration.

*Q.* With what is pleurisy apt to be confounded?



*A.* With peripneumonia.

*Q.* How are they distinguished?

*A.* The pain in pleurisy is acute, in peripneumony it is obtuse or deep-seated; in pleurisy external pressure gives pain, but it is not so in peripneumony. The dyspnœa in pleurisy is attended with acute pain, and full inspiration is impossible in peripneumony, owing to the oppression and the *obtuse* pain. The face in peripneumony is very red, even livid; in pleurisy it has the ordinary febrile redness. The pulse is full, strong, and hard in pleurisy, but in peripneumony it is oppressed, and not necessarily hard or full. Lastly, auscultation gives obscure sound in peripneumony, not so in pleurisy.\*

*Q.* What does the protracted pain in pleurisy indicate?

*A.* The continuance of inflammation; for inflammation does not suddenly, but gradually subside.

*Q.* What are the signs of suppuration in pleurisy?

*A.* Diminution of force and increase of frequency in the pulse; irregular chills, hectic flush, sweats, alteration of pain from acuteness to a sense of weighty pain, expansion of the affected side.

*Q.* What two modes are important in ascertaining the presence of pus?

*A.* Percussion is one; and pressure on the epigastrium, which, by throwing the pus up, occasions a sense of suffocation.

\* At the commencement of pleurisy, before any adhesions take place, or fluid is effused, the sound on auscultation is natural; but when the effusion is considerable from the commencement, or becomes so during the progress of the disease, the sound is dull. If the effusion is moderate, the sound is dull in the lower part of the thorax, both laterally and posteriorly.

Q. How does *chronic* pleurisy differ from phthisis?

A. The cough is drier, there are no night sweats; the pain is fixed, and in pleurisy there is local dropsy with its indications; whereas, in phthisis there is cellular dropsy.

Q. What effects have diseased lungs on the pleura?

A. They induce chronic pleurisy.

Q. Are there any certain indications of effusion in the *pericardium*?

A. If any one will distinguish it from surrounding disease, it is pressure on the epigastric region, which throwing up the fluid, occasions suffocation.

Q. What are the terminations of pericarditis?

A. In adhesion, suppuration, in effusion of serum, and in a greatly increased thickness.

Q. Is the *peritonitis* as local as the pain in that disease?

A. Although the pain may be locally very acute, yet the inflammation is diffused. It is the same case with pleurisy, in which the pain is pointed, although the inflammation is extensive.

Q. Whence does the vomiting in peritonitis arise?

A. It is sympathetic, not from irritating gastric contents.

Q. Mention a very remarkable distinction between peritonitis and dysentery.

A. In peritonitis the bowels are costive or natural, in dysentery the stools are characteristic of mucous irritation.

Q. How does peritonitis terminate?

A. In adhesions of the intestines to each other, in serous effusion, in the formation of pus, and in gangrene.

Q. Where are these adhesions most conspicuous?

*A.* In the large intestines. I have seen all the intestines perfectly glued together by adhesions in chronic peritonitis; they could not be separated.

*Q.* To what is the abdominal swelling in puerperal fever owing?

*A.* To a distention of the cellular texture subjacent to the serous membranes.

*Q.* What symptoms are peculiar to puerperal peritonitis?

*A.* The condition of the breasts, and the lochial discharge.

*Q.* Whence does ascites originate?

*A.* From idiopathic and symptomatic chronic inflammation of the peritoneum. The hydrocele is from acute or chronic inflammation of the *tunica vaginalis*.

*Q.* What are the diseases of the *arachnoid* membrane?

*A.* Phrenitis, hydrocephalus.

*Q.* Are there not other seats of these diseases in the brain than the *arachnoid* membrane?

*A.* As the other tissues in the cranium are not susceptible of inflammation, the answer is in the negative.



## SYNOVIAL SYSTEM.

*Q.* In what respects does this system resemble the serous?

*A.* In its form, the sac without opening; in its texture, which is cellular; and in its functions, those of exhalation and absorption.

*Q.* In what respects do they differ?

*A.* In the composition of their fluids. Dropsical affections of the cellular and serous tissues do not induce synovial dropsies, and vice versa. The synovial tissues are not so subject to tubercular diseases as the serous. Adhesions do not take place in the synovial tissues as in the serous. The synovial membranes are not locomotive as the serous were said to be. The fluids of synovial and general dropsy are not alike.

*Q.* How is the synovial system divided?

*A.* Into that of the joints, and that of the tendinous grooves.

### 1. *Of the Articular Synovial System.*

*Q.* How are the fluids of the system separated from the blood?

*A.* In three ways. By *secretion* from a gland, intermediate to the blood-vessels, which bring the blood, and the excretory which carries off the secreted fluid; by *exhalation*, where there is a direct continuity of blood-ves-

sel and exhalent, without an intervening gland; by *transudation*, which takes place after death.

*Q.* Why do you object to the formation of synovial fluid by *secretion*?

*A.* Because the glands, ducts, and other apparatus of secretion do not exist.

*Q.* Why do you oppose the doctrine of the *transudation* of the synovia?

*A.* Because the operation of transudation is in opposition to vitality, and compatible only with death in the vessels.

*Q.* Can you maintain the doctrine of *exhaled* synovia?

*A.* It is reasonable to adopt the doctrine of exhalation, because the serous and synovial fluids resemble each other, being both albuminous. The use of the two fluids is the same, both being destined to lubricate surfaces admitting of free motions. The serous and synovial fluids are both liable to be suppressed by inflammation. The synovial membranes, when they do adhere, in this resemble the serous. The two tissues are both liable to dropsy; and finally, both fluids are absorbed.

*Q.* What is the appearance of the synovial fluid?

*A.* It is a white, viscid, transparent, ropy, unctuous fluid, supposed to have a peculiar kind of albumen.

*Q.* What is the form of the synovial membrane?

*A.* A sac without an opening, spread on the articular surfaces.

*Q.* How is this form ascertained?

*A.* By dissection, and by the appearance of the membrane when thickened by disease.

*Q.* What difference appears between the fibrous capsules and the synovial membranes?

*A.* They are totally distinct, in function and organization, from those capsules, which last are found only in one or two articulations.

*Q.* What are the red fatty bunches found about the articulations?

*A.* They are points at which the blood-vessels going to the synovial membrane divide most minutely: but they are not glands, as has been supposed.

*Q.* What properties of texture and of life belong to this synovial tissue?

*A.* Slow extensibility, organic sensibility and insensible organic contractility. In disease the *organic* is exalted to *animal* sensibility, producing pain.

*Q.* What experiment proves the presence of fibrous capsules about a joint?

*A.* Twist a joint where these capsules are, and there is much pain; but where the synovial membrane exists alone, there is not this pain from twisting the joint.

*Q.* Are the sympathies of the synovial tissue active?

*A.* On the contrary they are few and weak.

*Q.* What is the function of this texture?

*A.* To exhale synovia for the lubrication of the joints?

*Q.* At what period of life does this tissue bear the greatest proportional development?

*A.* In the foetus and the infant; for the reason that the articulations are larger in a cartilaginous than in their osseous state.

## 2. *Synovial System of the Tendons.*

*Q.* Where is this found?

*A.* In the tendons of the extremities, but not in the trunk.



*Q.* What general observations have you to make on this tissue?

*A.* That in its organization, properties, functions, sympathies, it resembles precisely the articular synovial system.

*Q.* What do you mean by synovial fringes?

*A.* They are elongations and duplicatures of the membranes, from which the synovia is almost exclusively exhaled.

*Q.* Are there not points of difference in the serous and synovial systems, besides those already stated?

*A.* The serous tissues have more blood-vessels, more lymphatic, and apparently fewer laminae.

## GLANDULAR SYSTEM.

*Q.* How do you define a gland?

*A.* It is a body from which flows, by one or many ducts, a fluid, which this body separates from the blood received by vessels which go to it.

*Q.* What important peculiarity is found in this system?

*A.* That the texture peculiar to it is not precisely the same in all the organs that compose the system. The texture of the liver differs from that of the kidney.

*Q.* Name the glands.

*A.* Those on the head are, the salivary, the lachrymal, the meibomeian and ceruminous of the ear, and the amygdalæ. On the thorax, the mammæ. In the abdomen the liver, pancreas and kidneys. In the pelvis, the prostate and testicles. On the trunk and face the mucous glands.

*Q.* Are there glands on the extremities?

*A.* There are none.

### *Situation, Forms, Division, &c. of the Glandular System.*

*Q.* What is to be observed of the position of these glands?

*A.* They are in two situations, sub-cutaneous, and deep-seated.

*Q.* Does the motion communicated to the glands by the neighbouring parts, induce their excretion?

*A.* It does not. That operation is the result of vital action; still the motion given to some glands may be accessory to excretion.

*Q.* Under what circumstances is this accessory motion necessary?

*A.* It is found wherever the parietes of the organ are not very powerful.

*Q.* Besides the division of glands into sub-cutaneous and deep-seated, there is another, what is it?

*A.* Into single and double glands. The liver is a single gland; the kidneys are double, in pairs.

*Q.* Is there the exact symmetry in two glands of the same pair as is found in the organs of animal life?

*A.* There is not; because the harmony of action in animal life requires the utmost exactness.

*Q.* What circumstance materially controls these varieties of form in the glandular tissue?

*A.* The fact of their being invested by a strong membrane has great influence in this respect. The liver, which is contained in a membrane, has much fewer varieties than the lachrymal, or the salivary, which are without such investment.

### *Organization of the Glandular System.*

*Q.* In what is the texture of the glands peculiar?

*A.* The oblique or longitudinal fibrous linear arrangement met with in the muscular, osseous, nervous tissues, is not seen at all in the glands. They are agglomerated, and slightly united by cellular texture.

*Q.* How is the parenchyma of glands to be divided?

*A.* Into three forms.



*Q.* What are they?

*A.* There is first, the glandular parenchyma with larger lobes, separated from each other by cellular substance; these larger lobes are resolved into smaller lobes, which are agglomerated; and these smaller lobes are composed of glandular grains.

*Q.* What glands are thus organized?

*A.* The pancreas, the salivary and lachrymal glands.

*Q.* What is the second form of the glandular parenchyma?

*A.* It is that of glandular bodies connected by cellular substance without the lobulated structure of the first form.

*Q.* What glands are examples of this?

*A.* The liver and the kidneys.

*Q.* Designate the third form of the glandular parenchyma.

*A.* The third form comprising the amygdalæ and mucous glands have a soft, pulpy parenchyma, without lobes or grains.

*Q.* Is the organization of all the glands included in these forms?

*A.* It is not. The mammary glands and the testicles have a peculiar texture.

*Q.* What peculiar effect does ebullition produce on this glandular texture?

*A.* All the tissues acquire the horny hardening in the first ebullition, but as the boiling is continued they become soft. Now the glands differ from the textures in this, that the longer they are boiled the harder their substance becomes.

*Q.* What is the origin of the excretory ducts?

*A.* They arise as capillaries, one from each glandular

point in a gland; they unite and form ducts. These excretory ducts are known only in the glandular system.

*Q.* Is the number and arrangement of these ducts uniform in the glands?

*A.* They are not uniform in either respect. Some glands excrete by several ducts which do not communicate with each other; this you see illustrated in the nipple. There are some which excrete by a single duct; instances of which you see in the parotids, the sublingual glands, and the pancreas. There is a third set of glands which have reservoirs for their secretions, of which the liver, testicles and kidneys are examples.

*Q.* Where do the excretory ducts open?

*A.* They all empty themselves either on the external surface, or on the mucous membranes. They never open on cellular or serous surfaces, for the secreted fluids are all intended to be thrown off from the body.

*Q.* Can secreted fluids be introduced into the blood-vessels with safety?

*A.* They may be thrown in through the veins, or the crural artery; but not through the carotids, for then they make a fatal impression on the brain.

*Q.* What lines the excretories of the glands?

*A.* The mucous membrane.

*Q.* In what glands is there the greatest abundance of cellular texture?

*A.* In those glands which have the organization of a granulated white parenchyma, such as the heart, the pancreas, and the salivary glands.

*Q.* In what glands is there least cellular substance?

*A.* In those with compact parenchyma, as the liver, kidney, prostate and mucous glands.



*Q.* How do you explain the coexistence of extensive disease of the liver, and yet a secretion of healthy bile?

*A.* The cellular texture of the organ is diseased, while the peculiar glandular structure is unaffected.

*Q.* There are two causes for the size of the female breast, what are they?

*A.* It may be large from the size of the gland, and from an undue portion of cellular texture is another.

*Q.* How do the glands receive their arteries?

*A.* Those not invested with membranous expansions receive their blood-vessels, on all sides, from the surrounding parts. Those which have membranous coverings receive these vessels at one point, usually in a fissure, and they enter at that part of the gland which is least exposed to external injury.

*Q.* What are the ultimate arterial ramifications in a gland?

*A.* Each glandular grain receives a capillary artery.

*Q.* Has arterial motion any other effect on a gland than to circulate its blood?

*A.* Yes; it communicates an internal motion, very favourable to their functions.

*Q.* How does disease of the right auricle of the heart affect the liver?

*A.* By obstructing the flow of blood from the hepatic vein, it has a direct congestive influence on the liver. Hence at least one cause of the frequent simultaneous occurrence of diseased heart and liver.

*Q.* In what glands is there most blood?

*A.* It is in greatest quantity in the liver and kidney; and there is least blood in the pancreas, salivary, and lachrymal glands.



*Q.* Are the nerves of the glands cerebral or ganglionic?

*A.* Some receive cerebral nerves, such as the salivary, lachrymal, &c. others are supplied by the ganglions.

*Q.* Have the nerves influence on secretion?

*A.* Whatever influence they may exercise, it is not essential; for we find, in many instances, that secretion goes on, although the nerves of the part are destroyed.

### *Properties of the Glandular System.*

#### *1. Properties of Texture.*

*Q.* To what extent does the glandular tissue manifest properties of texture?

*A.* Extensibility and contractility of texture exist to a very limited degree.

#### *2. Vital Properties.*

*Q.* Have the glands the vital properties of animal life, to any great degree?

*A.* They have no animal contractility; but some of the glands, for example, the testicles, have, when pressed, and others have, when cut, much animal sensibility.

*Q.* Is the pain of an inflamed gland peculiar?

*A.* It is of a dull, obtuse character; not acute, as in the cellular texture, nor sharp and biting, as in the skin.

*Q.* What as to their properties of organic life?

*A.* Insensible organic contractility, and organic sensibility exist in their utmost activity in the glands. These are the prominent properties that control the functions,

and direct the pathology of glands. Sensible organic contractility is wanting.

*Q.* How is glandular secretion executed?

*A.* The blood contains the materials for secretion; the organic sensibility of the gland elects from the blood the appropriate elements, and the insensible organic contractility admits or rejects the fit or unfit elements.

*Q.* On what principle and power do secretion, exhalation, and nutrition depend?

*A.* On the power that organic sensibility exercises in the *gland*, to select the materials for *secretion*; in the *serous* membranes for exhalation; and in all the organs for *nutrition*.

*Q.* On what does increased or diminished secretion depend?

*A.* On an exaltation or depression of the predominant vital forces of the glands.

*Q.* How is it that each gland exercises a peculiar power so as to form its own secretion, as the liver to form bile, the kidneys urine, &c.?

*A.* The power depends on a modification of the organic sensibility in each organ.

*Q.* Are the glands easily affected by impressions from other parts?

*A.* These foreign impressions constitute the passive sympathies of the glands. They are numerous, and they appear in health and in the course of disease.

*Q.* Designate the normal passive sympathies of the glands?

*A.* The effect of aliments on the salivary glands, the irritation of the pituitary membrane producing tears; the



passage of food into the duodenum occasioning a flow of bile. These all take place on the mucous surfaces, and are passive normal sympathies.

*Q.* You have said that the passive sympathies of the glands were frequently abnormal or morbid.

*A.* They are so. Consider how the liver, kidneys, and mucous glands, are affected by diseases, and particularly the influence of diseased stomach on the mucous glands of the tongue.

*Q.* How do you explain the effects of grief on the glands of the eye?

*A.* The first impression of grief is on the epigastric region, and with this region the lachrymal glands sympathize.

*Q.* What glands are least disposed to assume abnormal sympathetic action?

*A.* The testicles and prostate glands, because their functions are insulated from the rest. But as the greater number of the other glands are intimately connected with the process of digestion, which process supports the very existence of all the organs; for this reason we say that these glands sympathize more readily and fully with all the organs.

*Q.* Are the active sympathies of the glandular system numerous?

*A.* They are not so much so as the passive. The most remarkable is the effect of the development of the testicles on the voice. The diseases of the generative system or seminal organ has much effect on the pulmonary mucous system.

*Q.* You have said that each gland has its modification of vitality, whence does this arise?



*A.* From peculiarity of texture. From these modifications of vitality and peculiarities of textures, it results that the different glands have certain substances in relation to them. From these, likewise, arise the peculiar sympathies of each gland, the particular character of the inflammation of each gland, and their predispositions to disease.

*Q.* Give some examples of the exclusive relation of certain glands with certain substances.

*A.* The conspicuous instance under this head is the fact, that one gland secretes one fluid, another a different one invariably. Again, this relation explains the operation of mercury on the salivary, and of cantharides on the renal glands.

*Q.* Will you state some of the peculiar modes of glandular sympathies?

*A.* There is that of the liver with the brain, the testicles with the pectoral organs; the disorders of the kidneys in exciting vomiting, the sympathy of the uterus with the mammæ.

*Q.* Give examples of the different inflammation in different glands.

*A.* The inflammation of the kidney differs from that of the liver; that of the prostate gland from the testicles. There is a difference in the symptoms.

*Q.* You have said that the glands have their particular forms of diseases, specify this position.

*A.* While the liver is subject to hydatids, the salivary glands and testicle never have them. Observe how much more frequent sarcocele is, than a scirrhus of the parotids.

*Q.* What characters appertain to the vitality of the glands?

*A.* They are the peculiarity of the life of the glands; the remittent action of glandular life; the whole of the glandular system is never increased in its vital forces at the same time; glandular vitality is influenced by climate and season; sex has great influence on the vitality of the glands. These are the remarkable characters in the vitality of the glands.

*Q.* What do you mean by remission in the glandular life?

*A.* It is this; that although secretion is constantly going on, yet it is much more active at some times than at others.

*Q.* How does season affect the glandular system?

*A.* In the winter the internal glandular system is active, and the skin torpid; while in summer the skin is active at the expense of the internal glands.

### *Development of the Glandular System.*

*Q.* What is the state of the glands in the fœtus?

*A.* Much developed, but inactive. There is little need for secretion, and no room for excretion in the fœtus.

*Q.* What causes excite the glandular system at birth?

*A.* The change in their blood from black to red; and the excitement carried to their excretories by air, food, and other irritations at their mouths.

*Q.* What glands are most disordered in infancy?

*A.* The mucous and lachrymal glands.

*Q.* Is the glandular system most diseased in infant life or after growth?

*A.* It is most diseased after growth. In infancy the lymphatic system is most affected, in adults the glandular.



*Q.* Mention some of the glands which are particularly active at different periods of life?

*A.* The lachrymal glands are most remarkably active in infancy; the genital glands are so in youth; the hepatic system is most energetic in adult life.

*Q.* How do you account for the activity of many glands in old age?

*A.* Decomposition requires many things to be cast off by the excretories; the functions of the skin ceasing, a determination takes place to the glands of the abdomen.

*Q.* Is the communication between the arteries and excretory ducts of a gland direct, or is there an intermediate substance?

*A.* In the liver, testicles, and kidneys, there is this evident, direct communication; but in others it is not demonstrable.

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#### PATHOLOGY OF THE GLANDULAR SYSTEM.

*Q.* What are the diseases of this texture?

*A.* Each gland has its own diseases. The glands differ in structure, are without common properties, and therefore in detailing diseases of the glands, each organ is to be separately mentioned.

*Q.* There are some affections in common with all glands.

*A.* These are enlargement and diminution of size.

*Q.* Inflammation has a common effect on all the glands.

*A.* It alters the secretions of all; it checks altogether the secretory action in many.



Q. What are the diseases of the *lachrymal gland*?

A. It is so little liable to disease, as to require no consideration here.

Q. Enumerate the salivary glands?

A. They are the parotid, the maxillary, and the sublingual.

Q. What are the diseases of the *parotid* glands?

A. Indisposed to suppurate, they inflame, enlarge, and resolve. They are the seat of mumps—they become scirrhus.

Q. Is it the substance of the gland or the surrounding tissue that enlarges so much in these cases?

A. It is doubtless ascribable to both; but the surrounding texture is materially concerned in it.

Q. What is the most frequent disease of the *liver*?

A. Inflammation, acute and chronic.

Q. Are the membranes and substance of the liver usually inflamed at the same time?

A. Not usually; the texture of the two varies.

Q. When does singultus appear in hepatitis?

A. When the convex surface is inflamed, the diaphragm is so irritated as to occasion hiccup. Cough is likewise more frequent in this case.

Q. What symptoms are specially connected with inflammation of the concave surface of the liver?

A. Vomiting.

Q. How does hepatitis terminate?

A. By resolution and suppuration.

Q. What are the products of chronic hepatitis?

A. Great enlargement of the liver, and again the opposite state of diminished volume

Q. There are other hepatic disorganizations?

A. Steatomatous tumours, tubercles, fatty depositions, hydatids, &c. It is not necessary particularly to notice jaundice, as it arises in common from the liver and gall-bladder. There are numerous symptomatic diseases of the liver.

Q. With what affections is inflammation of the *kidney* confounded?

A. With lumbago and phlegmon in the region of the kidney.

Q. What are the principal diagnostics?

A. The pain of nephritis is increased by pressure; and in nephritis the conditions of the urine are much altered.

Q. Name some other morbid states of the kidney.

A. There is flaccidity of the organ and hydatids.

Q. At what period of life does the *prostate* gland assume disease?

A. Not usually before puberty.

Q. What are the diseases of the prostate?

A. Inflammation, induration, varices, cancer.

Q. How do you, in diseases of the *testicle*, distinguish sarcocoele from hydrocele?

A. The sarcocoele is harder than hydrocele. This is one way to distinguish them.

Q. Are the testicles equally liable at all times of life to disease?

A. Like the prostate gland, they are seldom diseased before puberty.

Q. What are the principal diseases of the *mammary* gland?

*A.* Inflammation, ending in abscess during lactation—and cancer, chiefly at advanced periods of life.

*Q.* What have you to say of diseases of the *spleen*?

*A.* That inflammation of that gland is very rare; supuration is still more so. Intermittents chiefly induce disease of the spleen. It is liable to cartilaginous and osseous indurations.

*Q.* What is the disease of the *thyroid* gland?

*A.* Goitre.



## DERMOID SYSTEM.

*Q.* What are the uses of this texture?

*A.* To defend parts from external injury; to eliminate much of the residue of nutrition and digestion; and to throw it into relation with external bodies. It connects the existence of man with surrounding objects.

### *Forms of the Dermoid System.*

*Q.* There are several kinds of wrinkles on the skin, to what are they owing?

*A.* To the subjacent muscles, to the motions of parts, and to old age. In this last the wrinkles are owing to the removal of sub-cutaneous fat.

*Q.* If the sub-cutaneous fat be removed by emaciation in young persons, do you perceive wrinkles in the skin?

*A.* No; because the organic contractility is not lost, as in old age, and the skin adapts itself to the emaciated parts.

*Q.* How does the connexion of the skin with the subjacent parts in man, differ from that connexion in animals?

*A.* In animals the skin lies over a fleshy layer called panniculus, which the animal moves at pleasure. In man the only resemblance to this is the occipito-frontalis and the platysma myoides muscles.

*Organization of the Dermoid System.**1. Texture peculiar to the Organization.*

*Q.* What does the dermoid texture comprise?

*A.* The chorion, the reticular body, and the papillæ.

*a. Of the Chorion.*

*Q.* On what parts is the chorion thickest?

*A.* On the sole of the foot, the palm of the hand, the scalp, and on the back. It is thinnest on the female breast, on the penis and scrotum.

*Q.* In which sex is it thinnest?

*A.* In females.

*Q.* What modifications does the dermoid chorion exhibit on its internal face?

*A.* On the sole of the foot and palm of the hand it is firmly connected with the cellular substance by strong and numerous fibres. This fibrous connexion is important to the functions of the parts.

*Q.* What are the peculiarities of the internal face of the chorion on other parts of the body?

*A.* On the internal face over the body there are but few fibres, and the skin hangs loosely; between the fibres are spaces filled with small fatty parcels. On the back of the hand and foot, on the scalp, and where the beard grows, there are openings only for the hairs to go through, the surface being white and smooth.

*Q.* What effect has long maceration on the chorion?

*A.* It shows that the chorion on the external face is

actually perforated by foramina for the passage of the hairs, the nerves, blood-vessels, exhalents, absorbents, &c.

Q. What texture does the chorion most resemble?

A. In its appearance in certain parts, in its serving for the insertion of muscles, in its melting gradually into gelatine, and in some other respects, it resembles the fibrous tissue.

Q. On which surface of the chorion do eruptive diseases form?

A. On the external altogether. Phlegmon forms in the cellular substance beneath the chorion; the small-pox, erysipelas, &c. are found on the exterior face.

Q. What then are the functions of the chorion?

A. Being intended neither for sensation nor circulation, it serves to protect and defend the body.

#### *b. Of the Reticular Texture.*

Q. What do you understand by this?

A. It is a capillary net-work of vessels on the exterior of the chorion, forming with the papillæ a layer between the chorion and epidermis.

Q. What fluids are contained in this reticular texture?

A. Those which give the colour or teint to the individual.

Q. What proves that this teint is foreign to the chorion and epidermis?

A. These two having the same colour in whites and blacks.

Q. Is the reticular texture ever renewed after once being destroyed?

A. It is not; cicatrices are white in all persons.



*Q.* Is there not another set of capillaries in the reticular body besides that which contains the colouring principle?

*A.* Yes; there are those which furnish the exhalents of the perspiration.

*Q.* Why is this last portion of the reticular body so important to pathologists?

*A.* Because it is the seat of the eruptive diseases, erysipelas, &c.

*Q.* What is the reason that in serous effusions on the serous membranes, bladders of that fluid do not form, as on the skin?

*A.* Because on these membranes there is no epidermis to form the blister.

*Q.* What part of this reticular capillary system is most apt to be filled with blood?

*A.* The facial portion.

*Q.* What is the reason of this?

*A.* Because in the face the communication between the reticular texture and the arteries of the chorion is more free, and because the sensibility of the texture in the face is greater than it is elsewhere in that tissue.

*Q.* In what three modes does the face express the passions?

*A.* In the eye, in the muscles of the face, and in the facial reticular texture. This last is entirely involuntary.

*Q.* Can you say how this reticular tissue expresses the passions?

*A.* By the quantity of blood, as in blushing under mental emotion, and by the absence of blood, as in the paleness of fear.

*Q.* What pathological fact arises from this natural

susceptibility to increased sanguineous fulness in the face?

*A.* That in cutaneous diseases, especially variola, the face is most violently affected. The affections of this reticular tissue of the face are indicative in many cases of internal visceral disease.

*Q.* Repeat the two anatomical divisions of the reticular capillary system.

*A.* That which contains the colouring teint, and that which affords the fluids of transpiration.

### *c. Of the Papillæ.*

*Q.* What do you mean by these?

*A.* They are small eminences arising from the external chorion, which pierce the reticular surface, and become contiguous to the epidermis.

*Q.* What are apt to be confounded with these papillæ?

*A.* Certain cellular, vascular, or nervous bunches, or sebaceous glands, which are lodged in the small oblique canals, terminated by the openings of the chorion under the epidermis. These bunches or bundles, or eminences, are observable on the outside of the arms, and on the back.

*Q.* What occasions the petechiæ of adynamic fevers?

*A.* Extravasation of blood in the cellular texture of the small pores, which open on the exterior of the chorion, to transmit the hairs, &c. This occasions these petechiæ.

*Q.* What is the structure of the papillæ?

*A.* Analogy supposes them to be nervous terminations, but this analogy has not been sustained as yet by demonstration.



*Action of Different Bodies on the Dermoid Texture.*

*Q.* What effect has light on the dermoid texture?

*A.* It whitens it, and this independently of heat. A proof of this is, that clothing which does not exclude the influence of heat from the skin, prevents the blanching of the skin which light occasions.

*Q.* What are the effects of heat on the dermoid tissue?

*A.* The first effect is to expand the texture and increase the flow of fluids to and through it. In a higher degree, heat produces redness, a kind of erysipelas. Applied more powerfully, it reddens and vesicates the skin. In greater intensity it produces the horny hardening, and lastly, it is blackened and reduced to carbon.

*Q.* In the production of redness and vesication, on what does heat act?

*A.* On the vital forces of the part; but the subsequent steps are on the textural properties, and take place alike in the dead and living skin.

*Q.* Does the skin preserve an equality of texture?

*A.* It does. It prevents the effects of a greatly increased heat, refusing admission to the caloric; while in very cold countries, it prevents the rapid escape of animal internal heat. It is a curious fact, that internal organs exposed to the air do not thus resist the changes of temperature.

*Q.* How does cold affect the dermoid texture?

*A.* Variouslly, according to the degree at which it is applied. First it contracts the vessels so that the usually passing fluids cannot escape; the next degree produces dermoid redness; and lastly, it brings on gangrene.



*Q.* There are two phenomena in gangrene carefully to be distinguished, what are they?

*A.* The mortification of the part, and the putrefaction of the mortified part.

*Q.* What hastens the putrefaction of the mortified part?

*A.* The process is rapid in proportion to the quantity of blood it contains.

*Q.* Then antiseptic is a relative term, to be understood in a double sense?

*A.* It is; for it may prevent the mortification of a part, and also the putrefaction of a part already mortified. How different are these two objects.

*Q.* In what distinctive sense are the exhalation and solution of transpired fluids to be understood?

*A.* In this, that the exhalation of the perspiration is a vital phenomenon; its solution in the air is physical. They are totally independent of each other.

*Q.* Sweating, then, is owing to two causes wholly independent of each other, what are they?

*A.* The one is the increase of exhalation, the other is a diminished solution by the air of what is exhaled.

*Q.* What are the several causes which increase exhalation by the skin?

*A.* Whatever increases the determination of fluids to the surface, as severe exercise, fever, &c. are one set of causes. The exhaled fluid is increased by external causes, which relax and expand the cutaneous organ, as the heat of summer, warm bathing, &c. The action of the skin is sympathetically increased in diseases; you see this in the sweats of phthisis. The passions, by acting on the epigastric organs, increase sweating by sympathy.

*Q.* What effect has bathing in water on the skin?

*A.* It cleanses it from saline and oily matter. It may, in certain cases, increase or diminish the vital forces of the skin, but it does not alter its texture.

*Q.* At what season is bathing most useful?

*A.* In summer, when exhalation is greatest and most compound.

## *2. Parts common to the Organization of the Dermoid System.*

*Q.* Does cellular texture abound in the chorion?

*A.* It does, in great abundance. The chorion may be considered as a sponge, the interstices of which are filled with cellular texture. When the chorion has lost its cellular texture it is like a sieve.

*Q.* Do acute diseases affect the texture of the chorion?

*A.* They do not; they attack its cellular tissue. The chorion is disorganized in elephantiasis.

*Q.* Does the cellular texture of the chorion extend to its external surface beneath the epidermis?

*A.* The fact that granulations do not arise when the epidermis is destroyed would induce the belief that there is no cellular substance on the external surface of the chorion; because, wherever there is cellular substance, there you will see granulations, when the cellular texture is laid bare.

*Q.* There are two sets of absorbents on the chorion, name them.

*A.* Those which arise from the chorion and return its materials to the blood, and those which absorb foreign substances through the epidermis.



*Q.* Do you not beg the question, in asserting the existence of cutaneous absorption, as the term is ordinarily accepted?

*A.* The following considerations establish its existence. The sub-cutaneous absorbents are vastly too numerous in proportion, to carry back the fat and serum of the parts; they must therefore have other offices. Mercury, cantharides, emetics, and purgatives, are evidently absorbed. Bichat, while in a dissecting room, breathed through a tube communicating with the external air, yet his breath was as fetid as if he had inhaled it by breathing the air of the room. This proves that there is some other route for the vapour of the dissecting room, than by the lungs; this is the skin.

*Q.* What reason is there for denying the nervous transmission of these metallic and other odours and vapours?

*A.* The fact that in certain punctures the whole course of the absorbents and glands is affected; and particularly that by frictions, and transfusions into the veins of the same substances used in frictions, similar effects are produced.

*Q.* How do you account for the experiments which disprove cutaneous absorption?

*A.* They are explained by the ever-varying sensibility of the skin. This is witnessed every day in the reception or rejection of contagions, such as the vaccine and small-pox.

*Q.* What persons and circumstances are most favourable to cutaneous absorption?

*A.* Children and women are the persons most susceptible of contagions; and, as during sleep and hunger the



vital forces are feeblest, it is under those circumstances that the skin is most susceptible of the action of these poisons.

*Q.* How are the cutaneous absorptions from which diseases arise to be divided?

*A.* Into those which act through the cuticle, as the itch, herpes, tinea, and the pestilential diseases; and into those which require the removal of the cuticle, as the vaccine, variola, hydrophobia, the bite of the viper.

*Q.* Where do the cutaneous exhalents arise?

*A.* From the external capillary system which surrounds the chorion and embraces the papillæ.

*Q.* What proves the existence of exhalents?

*A.* It is proved by the injections which are poured out on the skin, and the sanguineous exhalation in the form of bloody sweating.

*Q.* To what cause are many winter coughs to be ascribed?

*A.* To irritating matters, which in pulmonary transpiration are lodged in the lungs; and this accounts for coughs which are irritating without increased mucous effusion.

*Q.* Where are the cutaneous exhalents most abundant?

*A.* In the face and chest, where sweating is most profuse.

*Q.* What effect has season on cutaneous transpiration?

*A.* It is most abundant in summer. In winter the pulmonary exhalation and urinary secretion act vicariously.

*Q.* Whence is the source of the oily fluid which is thrown out on the skin?

*A.* It is an oily exhalation, such as that of fat which takes place in the cellular tissue. Bichat has never been able to discover sebaceous glands.

*Q.* What is the office of this oily fluid?

*A.* It serves to soften the skin so as to prevent its cracking.

*Q.* Why not consider this oil as an exudation of fat through the skin?

*A.* Because, in several parts where there is the least fat, there is the most oil, and vice versa. Besides, physical transudation is denied on vital principles.

### *Properties of the Dermoid System.*

#### *1. Properties of Texture.*

*Q.* What properties of texture are found in the dermoid tissue?

*A.* Extensibility and contractility to great extent. See this in dropsies, in pregnancy, in tumours. Observe how the skin retracts in a wound. You will find that these properties of texture are manifested in dead bodies. They are not dependent on vital forces, but derive an increase of energy from them.

*Q.* When the extension of the skin is increased, what takes place in the fibres of the dermis, and in the spaces between them?

*A.* The fibres are separated, and the spaces increase.

*Q.* How is the contraction of the dermoid texture from cold explained?

*A.* The fibres and spaces are much diminished on the inner surface of the chorion; but as the external face of the chorion does not contract in the same degree, a roughness is occasioned.



*Q.* In cases of dermoid extension, is the chorion rendered thinner?

*A.* It is in almost every case.

## 2. *Vital Properties.*

*Q.* What property of animal life is most conspicuous in the skin?

*A.* Above all others, animal sensibility.

*Q.* What functions does this property govern?

*A.* Those of feeling and of touch.

*Q.* In what does feeling differ from touch?

*A.* Feeling perceives the impression and general modifications of surrounding bodies; touch ascertains the special modifications of those bodies, as to form, dimensions, &c.

*Q.* In what does touch differ from other senses?

*A.* Touch requires no peculiar modification of sensibility; the eye, the ear, the organ of smelling, all require this peculiarity of sensibility. The touch is exercised on the qualities of bodies emphatically tangible, and not on their colour, flavour, and such like qualities. The touch is exercised from voluntary impulse; it is not so with the other senses. Touch is an operation somewhat consequential to the action of the other senses. All the other senses require not only peculiar sensibility, but a peculiarity of structure; whereas accurate touch only requires form convenient for exposing surfaces of contact; such form is seen in the hand of man.

*Q.* What part of the dermoid texture belongs to animal life, and what to organic life?

*A.* The papillæ are governed by animal sensibility.



The reticular body belongs to organic life. The chorion is passive.

*Q.* When the animal sensibility of the papillæ is exalted in disease, what peculiar symptoms are presented?

*A.* A smarting, burning pain, known only to the papillæ; such is the case with blisters, erysipelas. You have itching, which is a sensation also peculiar to the papillæ, as well as the curious sensation from tickling. None of these sensations are known on the mucous, serous or other tissues.

*Q.* Is there any other particular of the papillary animal sensibility worthy of notice?

*A.* That it is much regulated by habit, as you see in the exposure of the skin in some nations; the nakedness of some, and the full dress of others.

*Q.* What destroys feeling?

*A.* Inflammation, paralysis, and other morbid states.

*Q.* When animal sensibility is in exercise, is there an erection of the papillæ?

*A.* Observation would answer in the negative.

*Q.* Does animal contractility exist in this texture?

*A.* It does not.

*Q.* What functions presuppose the activity of organic sensibility and of insensible organic contractility in this texture?

*A.* Exhalation, absorption, the exhalation of the oily matter, the capillary circulation, and the nutrition of the whole dermoid texture; and lastly, the excitement from external bodies.

*Q.* How are the diseases of the skin to be divided?

*A.* Into those of the papillæ in which animal sensibility is exalted or diminished; the first in certain acute sensibi-

lities, the second in paralysis. Next, there are the diseases of the cellular texture of the chorion, as the inflammation of that texture over a bile or phlegmon. Then there are diseases of the external capillary net-work, as erysipelas, herpes, measles, scarlatina. The chorion, lastly, is subject only to chronic affections, as elephantiasis.

*Q.* What important inference is to be deduced from this division of the diseases of the skin?

*A.* That all those diseases, except those in which animal sensibility is exalted or diminished, proceed from an alteration of the organic sensibility and insensible organic contractility of the parts. And it is from these alterations that numerous phenomena are to be accounted for, as the failure of blisters to draw from too much or too little excitement, in the greater or less sweating at different times.

*Q.* Will you enumerate some remarkable passive sympathies of the dermoid texture?

*A.* One very striking one is the sensation of cold produced by disorder of the internal organs; these affect the animal sensibility of the skin. Flushes of heat are also from this cause. Digestion, the emission of semen, the diseases of the serous and mucous systems, all produce chilliness.

*Q.* The sensations, then, of heat and cold, arise from various causes?

*A.* Yes. They arise from an increase or diminution of atmospheric temperature; from preternatural development in some diseases, as of heat in phlegmon; there is a diminution of heat in other cases, as where an artery is tied. Caloric is disengaged sometimes, generally or locally, without inflammation; lastly, there are sympathetic sensations of heat and cold.



*Q.* Are the organic vital properties of the dermoid texture sympathetically affected?

*A.* They are; as when cold drinks check, or warm fluids taken into the stomach, increase perspiration.

*Q.* Whence the most usual excitant of these passive cutaneous sympathies?

*A.* They most frequently arise from the mucous membranes of the stomach; but they often proceed likewise from the lungs.

*Q.* What are the *active* sympathies of the papillæ?

*A.* When vomiting or syncope follow tickling, you have an example of an active cutaneous sympathy.

*Q.* How do the organic forces of the dermoid texture excite active sympathies?

*A.* These sympathies are produced not by translation of morbid matter, nor by the repercussion of fluids, but by exciting the predominant vital forces of the sympathizing organs.

*Q.* Give an example of this.

*A.* In inflammation of the thoracic serous membrane, the perspiration is checked by cold. What does this mean, but that the organic vital forces of the external capillary tissue of the skin are altered; a sympathetic impression is made on the organic forces of the exhalents of the pleura; these last, which only admit serum in health, are placed in relation to blood, and inflammation takes place.

*Q.* At what season of the year are the organic forces of the dermoid texture most exalted?

*A.* In the hot seasons; hence the active sympathies are then most prevalent, and most to be dreaded.

*Q.* How is it that the active cutaneous sympathies vary in different persons?



*A.* Because of the great difference, in various persons, in predisposition to disease. In one, a cutaneous sympathy excites the predominant forces of a serous, and in another of a mucous tissue.

*Q.* Why is it that the sympathies of animal contractility, and of sensible organic contractility in the skin are not active?

*A.* Because the dermoid texture has not these properties.

*Q.* What are the important characters of dermoid life and vital forces?

*A.* Animal sensibility is more acute in some parts than others; it is more acute in the palms of the hands and soles of the feet, and in the hypochondriac regions. Organic sensibility varies in force in different parts.

*Q.* There is an important difference between the animal and organic forces of the dermoid texture, what is it?

*A.* The animal vital forces of the skin are intermittent in action, the organic forces are continually operative. During sleep, these organic forces are said to be increased in activity.

*Q.* What arises from this increased activity of the organic vital forces of the skin during sleep?

*A.* Hence it is that those diseases have their exacerbations at night, which affect mostly the organic forces; whereas those that affect the animal vital forces of the skin, are not thus exacerbated at night.

*Q.* What effect has sex on the cutaneous vital forces?

*A.* The animal vital forces of the skin are more acute in the female than in the male sex.

*Development of the Dermoid System.*

*Q.* At what period of life does most blood enter the skin?

*A.* In the fœtal period. In advanced life there is least blood in the dermoid texture.

*Q.* What evidence is there that the organic vital forces of the skin in the fœtus are active?

*A.* The formation of the unctuous viscid fluid which is seen on the fœtal skin. Perhaps the liquor amnii is formed and absorbed by the fœtal skin.

*Q.* What do you infer from the fœtal skin remaining livid some time after birth?

*A.* That the pulmonary function is not free.

*Q.* At what period of life is there least sweating?

*A.* During childhood and infancy.

*Q.* Why does the skin radiate active sympathies more freely when it is sweating than when dry?

*A.* Because, while perspiring, its organic vital forces are most active; and hence these sympathies.

*Q.* What substance predominates in the skin of childhood and of age?

*A.* In early life, gelatine predominates; and in age, a fibrous substance.

*Q.* Why is the skin a more frequent source of disease than other textures?

*A.* Because, from its exposed situation, it is liable to so many variations of its vital forces.

*Q.* Why is it that touch is more actively employed in infancy and childhood than in old age?

*A.* Because every thing is novel to the young, and known to the aged.



*Q.* Whence the oily matter on the skin, according to Beclard?

*A.* He supposes it to be secreted by the sebaceous glands, which resemble in structure the mucous glands.

*Q.* What are the striæ so often seen on the abdomens of women who have borne children?

*A.* Cicatrices in the skin, the consequences of excessive distention.

*Q.* What texture gives rise to warts?

*A.* The dermis.

*Q.* What are the different sources of horny, cutaneous elevations?

*A.* They arise sometimes from the cicatrices of wounds; again, from the sebaceous follicles; and lastly, from the horny layer of the skin.

*Q.* Whence the wens, the atheromas, the steatomas, and melicerous tumours?

*A.* They are morbid enlargements of the sebaceous follicles.

*Q.* In what part of the dermoid texture is tinea seated?

*A.* In the sebaceous follicles.

*Q.* Where are the nævi materni seated?

*A.* In the vascular net-work, the reticular texture.

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#### PATHOLOGY OF THE DERMOID TEXTURE.

*Q.* How are the diseases of the skin to be divided?

*A.* Into the idiopathic and symptomatic.

*Q.* What is the seat of the symptomatic cutaneous diseases?



*A.* They are seated in the capillaries of the reticular and teguments external to the chorion.

*Q.* How are the cutaneous textures affected by distention?

*A.* In great distention, the fibres of the chorion are torn and separated; folds and wrinkles also arise from this cause.

*Q.* What effect has chronic disease on the skin?

*A.* It deranges the dermoid texture, rendering it rough and sallow.

*Q.* What division of the causes of *erysipelas* do you make?

*A.* They are external and internal, or extrinsic and constitutional.

*Q.* Where is *erythema* or *erysipelas* seated?

*A.* In the reticular texture; the chorion is unaffected.

*Q.* Is the chorion always sound in *erysipelas*?

*A.* In some cases the intense phlogosis affects that part of the skin, and even the subjacent cellular texture; and in these cases there is phlegmon, with great *erysipelatous* tension.

*Q.* What is the nature of the pain in *erysipelas*?

*A.* It is an acute but burning pain.

*Q.* Where is *erysipelas* most violent and dangerous?

*A.* On the head and face.

*Q.* Why is this?

*A.* It is owing to the peculiar vascularity and irritability of the reticular texture of the face, and the danger proceeds from the cerebral symptoms which cephalic *erysipelas* induces.

*Q.* What do you call *erysipelas* of the trunk?

*A.* It is the *herpes zoster*, the shingles,

Q. What are the terminations of erysipelas?

A. The mildest termination is in desquamation; it ends in phlyctenæ, in œdema, and in suppuration, in which case there is phlegmon.

Q. Does erysipelas manifest metastasis?

A. It shifts from place to place; and in some cases the translations, or the sympathetic phenomena, are on internal organs, as the brain, and are usually fatal.

Q. What texture is the seat of *measles*?

A. That disease is in the reticular texture external to the chorion.

Q. Where are the pustules of *small-pox* located?

A. In the chorion.

Q. Are all the *herpetic* affections located in the same parts of the dermoid texture?

A. No; some affect the reticular texture, and others are deeper seated, and involving the chorion. Some of the herpes are diseases of the sebaceous follicles.

Q. Which is the seat of *tinea*?

A. Most of the forms of tinea are found on the surface of the chorion; but the tinea favosa arises from the sebaceous follicles.

Q. Whence do *warts* originate?

A. From the chorion.

Q. Where are *secondary syphilitic* symptoms seated?

A. In the vascular reticular texture.

Q. Whence do the *horny* excrescences proceed?

A. From sebaceous follicles.

Q. In a former conversation you said the anthrax arose from a strangulation of the cellular texture.

A. Yes; but there is another opinion, that the eschars

of anthrax and furuncle proceed from specific secretory deposition.

**Q.** What is the difference between sympathy of heat and sympathetic heat?

**A.** In sympathy of heat there is a delusive impression that the skin is very hot, when its temperature is not elevated. Sympathetic heat means the heat of one organ occasioned by a disease of another part.



## EPIDERMOID SYSTEM.

*Q.* Why is the epidermoid texture considered separately from the dermoid?

*A.* Because its organization, properties, functions, and growth, differ from those of the dermoid.

*Q.* What belongs to the epidermoid tissue?

*A.* The external epidermis, the mucous epidermis, and the nails.

### *Of the External Epidermis.*

*Q.* What passes from the dermis through the epidermis?

*A.* The exhalents and hairs. The absorbents pass from without inward.

*Q.* What causes destroy the adhesion of the cuticle to the cutis?

*A.* Inflammation of the skin, cutaneous eruptions, idiopathic fevers, diseases of the viscera, and violent rubefacients.

*Q.* How do these causes act?

*A.* By an alteration of the vital forces of the parts, perhaps of the dermis.

*Q.* What is the organization of the epidermis?

*A.* It is a single layer over the whole body, except on the palms of the hands and bottoms of the feet; no fluid penetrates it; it has neither nerves nor cellular texture;

it is the most incorruptible of the textures. It is almost inorganic.

*Q.* Has it vital forces?

*A.* It has none; it is destitute of sympathies.

*Q.* How then would you describe the epidermis?

*A.* As a semi-organized, or even inorganic body, placed by nature between external inanimate substances, and the organized dermis, in order to assist their passage and guard against their force.

*Q.* How does it differ from other tissues?

*A.* In the property of reproduction; and from some textures it differs in this, that whereas, in diseases these textures assume animal sensibility, foreign to them in health, and thus feel pain, the epidermoid system is incapable, either in health or disease, of assuming animal sensibility.

*Q.* How are the epidermoid pores seen?

*A.* Their places are seen in those of the distinct drops of sweat on the skin; the pores can be seen if a piece of epidermis be held up between the eye and a strong light, but you cannot distinguish the exhalent from the absorbent pores.

*Q.* What unites the epidermis to the cutis?

*A.* The exhalents, absorbents, and hairs.

*Q.* Whence arises the thickness of the epidermoid system on the hands and feet?

*A.* It arises from numerous epidermoid layers, and perhaps there is some unknown difference in the organization.

*Of the Internal Epidermis.*

*Q.* Where do you find this?

*A.* At the entrance of the mouth, of the anus, of the urethra, and of the nasal fossa. As it passes along the mucous surfaces, it gradually disappears; in the stomach it disappears at the cardia.

*Q.* Does it exist in the deep-seated mucous membranes?

*A.* It does not; it is lost on them.

*Q.* What are the properties of the mucous epidermis?

*A.* They are the same with those of the external epidermis.

*Q.* What are its uses?

*A.* The same with those of the external epidermis, to defend the subjacent papillæ.



## OF THE PILOUS SYSTEM.

*Q.* What is the organization of the hairs?

*A.* An external epidermis, and an internal vascular tissue, which is the pilous texture.

*Q.* What reason have you for supposing the internal texture vascular?

*A.* Because, in disease, as the plica polonica, the hair bleeds.

*Q.* To what texture is the pilous analogous?

*A.* To the reticular of the skin, which has a colouring and a vascular tissue.

*Q.* What phenomena depend for explanation on the vascular character of the internal texture of the hair?

*A.* The change of colour of the hair suddenly, from fright, grief, &c.; the bleeding of the plica polonica; the pain of the head from cutting, or from too much hair.

*Q.* What is the origin of the hair?

*A.* It arises from the sub-cutaneous fat or the cellular texture. Each hair is contained in a small, membranous canal.

*Q.* Have the hairs vital properties?

*A.* They are destitute of animal sensibility, but organic forces are seen in the diseases of the hair. They are said to have nerves.

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## ERRATA.

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- Page 19, line 17, for *and have*, read *and their diseases have*.  
20, " 14, for *The senses*, read *Those of the senses*.  
22, " 15, for *receptions*, read *reception*.  
26, " 19, for *is*, read *be*.  
29, " 20, for *larger*, read *longer*.  
31, " 15, for *yet to be*, read *to be*.  
33, " 25, for *faculty which*, read *faculty by which*.  
41, " 14, for *its*, read *their*.  
44, " last, for *seated in*, read *from*.  
47, " 28, for *that of*, read *is that of*.  
48, " 1, for *brain*, read *lungs*.  
49, " 9, for *effluvia*, read *effluvia*.  
49, " 23, for *forced*, read *inspired*.  
100, " 30, for *viscera*, read *organs*.  
105, " 5, for *when*, read *where*.  
107, " 22, for *on*, read *in*.  
113, " 27, for *this differ*, read *the lining membrane differ*.  
134, " 25, for *ventricles*, read *ventricle*.  
142, " 18, for *of healthy serous*, read *of serous*.  
145, " 29, for *irritation*, read *invitation*.  
277, " 28, for *heart*, read *breast*.











